Project Report

on

Smart Trolley System

submitted as partial fulfillment for the award of

BACHELOR OF TECHNOLOGY DEGREE

SESSION 2022-23

in

Computer Science & Engineering

By

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May, 2023

DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that Project Report entitled "Smart Trolley System" which is submitted by Anupriya Yadav, Bhawna Shukla, Gayatri Sahu & Sakshi Maurya in partial fulfillment of the requirement for the award of degree B. Tech. in Department of Computer Science & Engineering of Dr. A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

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ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the report of the B. Tech Project undertaken during B. Tech. Final Year. We owe special debt of gratitude to Dr. Gaurav Agarwal, Department of Computer Science & Engineering, KIET, Ghaziabad, for his constant support and guidance throughout the course of our work. His sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only his cognizant efforts that our endeavors have seen light of the day.

We also take the opportunity to acknowledge the contribution of Dr. Vineet Sharma, Head of the Department of Computer Science & Engineering, KIET, Ghaziabad, for his full support and assistance during the development of the project. We also do not like to miss the opportunity to acknowledge the contribution of all the faculty members of the department for their kind assistance and cooperation during the development of our project.

We also do not like to miss the opportunity to acknowledge the contribution of all faculty members, especially faculty/industry person/any person, of the department for their kind assistance and cooperation during the development of our project. Last but not the least, we acknowledge our friends for their contribution in the completion of the project.

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ABSTRACT

Modern technology has increased the standard of living for humans. This resulted in large crowds at shopping malls. To handle the large crowd, we must reduce the process of billing time. This is done using a smart shopping system based on RFID. Items that are put in a smart shopping cart are read one by one and the bill is generated and displayed. After the final bill is generated the customer pays the bill by using their Pre-charged cards provided by the shopping mall. The aim is to reduce the time consumption needed for the billing system. With the advancement of technology, the level of acceptance of people of all ages towards electronic accessories is increasing day by day. Electronic accessories such as smart card readers, bar code scanners, and radio frequency identification are gaining more attention, especially in shopping malls. In Sri Lanka, cities with popularisation create a huge rush in shopping malls and supermarkets Though they have several counters, only one customer can be served at a time, the rest should be waited in a queue until the whole billing process is completed. Such long queues he shopping malls create unpleasant experiences for the customers. In this study, a smart shopping system is introduced by addressing the above-mentioned issues and has attempted to overcome the discomfort that the customer would undergo during the current shopping process. The Internet of thing-based smart shopping cart navigates the customer to the exact item location through the shortest path based on the customer purchasing list uploaded via his mobile. The cart itself can recognize radio frequency-tagged consumables in the shopping mall and billing is automated accordingly.

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LIST OF ABBREVIATIONS

IoT	Internet of Things
RFID	Radio Frequency Identification
IR sensor	Infrared Radiation
HC 12 Transceiver	Half Duplex Communication Module
SOC	System on a Chip
ESP	Espressif Module
Node MCU	Node Microcontroller Unit
LCD	Liquid Crystal Display
Wi-Fi	Wieless Fidelity
LED	Light Emitting Diode
MfRc 522	Micro Frequency Radio Communication Module
RC522	Radio Communication Module
EM 18	Electromagnetic Module
TX	Trasmitter
RX	Receiver
TN	Twistered Nematic
IPS	In Panel Switching
VAP	Vertical Alignment Panel
AFFS	Advanced Fringe Field Switching
UHF	Ultra High Frequency
PCB	Printed Circuit Board

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

As the century progresses, a number of advancements and information technologies will significantly alter both our expectations and worldview. Shopping is the key activity where people spend the most time. According to a report, we can spend between one and two hours shopping, and most customers always choose to leave a big queue.

At the current world, shopping carts and baskets are available at every supermarket and mall for shoppers to keep their purchases. Customers must proceed to the billing counter for checkout once their purchasing is complete. Here, the billing procedure takes a long time and necessitates adding more staff to the billing area. To solve this issue, we are installing an RFID-based smart tram system to reduce traffic and save time on labor-intensive tasks. Our prototype contains a few improved features that will fix the queue problem. A buzzer, LCD display, Arduino Uno, RFID tag, and RFID reader are all included in the smart trolley system. A product has an RFID tag connected to it.

1.2 PROJECT DESCRIPTION

When a customer places a product in the trolley, the RFID reader immediately scans the items, and the LCD displays information about the product name, price, and quantity. The customer only needs to pay the amount and walk away from the counter once the transaction has been completed and the server has received the information about it.. Thus, it has the ability to increase the customer's buying experience and make it simpler, faster, and more effective. Existing barcodes, which are still in use despite having significant shortcomings including a direct line of sight operation and a scanning range of only a few inches to a few feet, can be replaced by RFID since they offer additional advantages. One product can be read by a barcode reader at once. Optical technology powers barcode systems. A significant amount of human effort is required for barcode. On top of that, the durability of barcode tags is limited. The RFID tags also have the advantages of being stronger and having the ability to read and write data, including encrypted data. Furthermore, RFID tags can store a lot of information by giving a special identification number, including product details, price, size, and other details.

The process of product identification is made simpler and easier with the aid of RFID technology. The controller uses an RFID reader to operate the shopping cart and scan each item that is being purchased. A distinctive RFID-based membership card with personal data will be given to each new customer. He or she might use the membership card to deduct money from the final bill after finishing their shopping, or they could use the app. This idea fits consumers' core expectation, which is to make purchasing easier. As the product information is available and shown in the cart, one can bill the purchased item themselves by controlling the RFID technology-based shopping cart without worrying the presence of employees in shopping malls or supermarkets. By eliminating the cashier and the money spent on them, the project's outcome will benefit both the customer and the store owner.

CHAPTER 2

LITERATURE REVIEW

As per our knowledge only few papers were found in the literature for the automated shopping trolley for supermarket using RFID. The automated shopping trolley for supermarket billing system implemented by Sainath (2014), exploited barcode for billing of products, where customer scans the product using barcode technology. The bill will be forwarded to the central billing system where customer will pay them by showing unique id. The limitation of barcode scanning requires line of sight for scanning and it should be fixed within its boundary. Cash register lines optimization system using RFID technology by Budic (2014), developed a system for shopping using RFID. The RFID is employed for scanning products and the information is stored in the database which could be paid online or in a central bill. It also uses web application to maintain entire shopping details. It requires maintenance of web application server. No necessary steps have been taken for the products that are accidentally dropped into the trolley by the customer. IOT based intelligent trolley for shopping mall by Dhavale Shraddha (2016), applied RFID technology for billing during purchase in shopping malls and IOT is used for bill management by means of ESP module. The payment details will be sent to the server by which central billing unit will deal with customer's payment. The ESP module will be working as a short distance Wi-Fi chip for wireless communication.

2.1 Smart shopping trolley using RFID

The mall and market are great places for customers to buy the items they need on a daily basis, such as name-brand groceries, clothing, and home décor. A consumer uses an RFID reader to scan the item and place it in a shopping cart after traveling to a mall to do his or her shopping. The quantity of the goods is then shown on the LCD, helping the customer establish a budget. Every item has an RFID tag. If the consumer decides against buying the item, he will scan it once more, and it will then be taken out of the trolley. The customer will use the push button in the shopping cart to complete the billing once he is through shopping.

.2.2 RFID-Based Smart Trolley for Automatic Billing System

In the paper, the "Elegant Shopping Cart System" is presented, which will use an RFID reader, transmitter, and receiver to calculate the cost and save a record of the products that are purchased. Based on a consolidated database of user purchases, the system will offer product recommendations. Each product in the market is attached to an RFID tag in the "Smart Shopping Cart System," Moreover, an RFID reader is included with each trolley, an LCD display, an alphanumeric display, a transmitter, and a receiver.

2.3 Shopping and Automatic Billing Using RFID Technology

In order to construct an "on the spot" billing supermarket, this article offers an architecture that combines radio frequency identification (RFID) with wireless technologies. The shopping cart utilizes an RFID reader and tag-based system application, and as a result, RFID cards are employed as secure access to the goods. The product name, price, and total value of all the items purchased are displayed on the liquid crystal display (LCD), which is mounted on a cart. Using ZigBee connectivity, the host computer creates foot notation. The Proteus software system and hardware are used to simulate software systems and the microcontroller 18F46K22 respectively.

2.4 System Details

Smart Cart using NodeMCU and RFID is an efficient system when it comes to scanning of products, bill generation and payment. It uses an NodeMCU , a RFID reader, an LCD, buzzers, etc. and also RFID tags to be attached on the products. The RFID reader shall be used to scan the RFID tags present on the product and all the information received from the tags shall be stored in the NodeMCU. The product can be directly scanned by the reader and if the customer wishes to remove any product, they just have to. After the purchasing product total amount of bill generated and display on LCD of the trolley and also at the billing section. When customer goes to billing section he has to only pay the amount. LCD screen will show the total bill of the items present in the cart. System does not have a user interface and NodeMCU is used instead of WiFi module.The smart shopping with the trolley application state about creating an automated and centralized billing system that can be used in malls and supermarkets. The customers need not wait in the queue at the billing counters for their bill payment because total amount is generated on the LCD, Customer just have to go at billing counter and pay the payment.

2.5 Proposed Algorithm

The RFID based smart trolley consists of trolley that incorporated with RFID reader. As soon as the customer place the product they want to buy ino the trolley, the RFID reader attach to the trolley detect the RFID tag number of the product to identify it. Each RFID tag number is linked to a product it describes. All the information regarding the product associated with the RFID tag is in database can be retrieved using centralized server. All the activities are coordinated together using a NodeMCU. The product can be directly scanned by the reader and if the customer wishes to remove any product, they just have to again scan the product, then the product should be deleted. After the purchasing product total amount of bill generated and display on LCD of the trolley and also at the billing section. When customer goes to billing section he has to only pay the amount.

Algorithm:-

Step1: Start
Step 2: Put the product attached with RFID tag into trolley.
Step 3: RFID reader reads the tag information.
Step 4: The NodeMCU sends this information to the server via the WiFi module.
Step 5: The server stores the information in the database.
Step 6: The total amount is calculated into the server.
Step 7: Final amount get displayed in the server.
Step 8: Payment of the bill.
Step 9: The database is updated.
Step 10: stop

CHAPTER 3

IMPLEMENTATION OF RFID TECHNOLOGY

3.1. DEFINING RFID:

RFID or Radio Frequency Identification System is a technology-based identification system which helps identifying objects just through the tags attached to them, without requiring any light of sight between the tags and the tag reader. All that is needed is radio communication between the tag and the reader.

Radio Frequency Identification (RFID) technology has been attracting considerable attention with the expectation of improved supply chain visibility for both suppliers and retailers. It will also improve the consumer shopping experience by making it more likely that the products they want to purchase are available.

3.2. THE BARCODE HISTORY:

A small group of Harvard University students in London created the first barcode in 1932 by transmitting a bright light through Morse code. This was the beginning of automatic product identification. It began to develop into a bar-coding system in 1948, and by 1967, the technology was available for general use.

A packet of Wrigley's gum featured the first bar code technology in the retail industry in 1967. Forty-eight years later, the variety of uses for bar code technology has skyrocketed, spanning well beyond. A barcode is a way to express data in a way that is aesthetically and mechanically readable. At first, parallel lines of varied lengths, spacings, and diameters were used to represent data in barcodesThese barcodes, which are now typically referred to as linear or one-dimensional (1D), can be scanned by a specialised optical sensor called a barcode reader. Later, two-dimensional (2D) variations were created utilising hexagons, dots, rectangles, and other patterns. These are known as 2D barcodes or matrix codes even though they don't actually employ bars. Purpose-built 2D optical scanners, which come in a variety of designs, can read 2D barcodes. 2D barcodes can also be read by a digital camera attached to a computer running software that takes a picture of the barcode and analyses it to decipher and decode the 2D barcode. Using specialised application software, a mobile device with a built-in camera, such as a smartphone, can perform as the latter kind of 2D barcode reader.

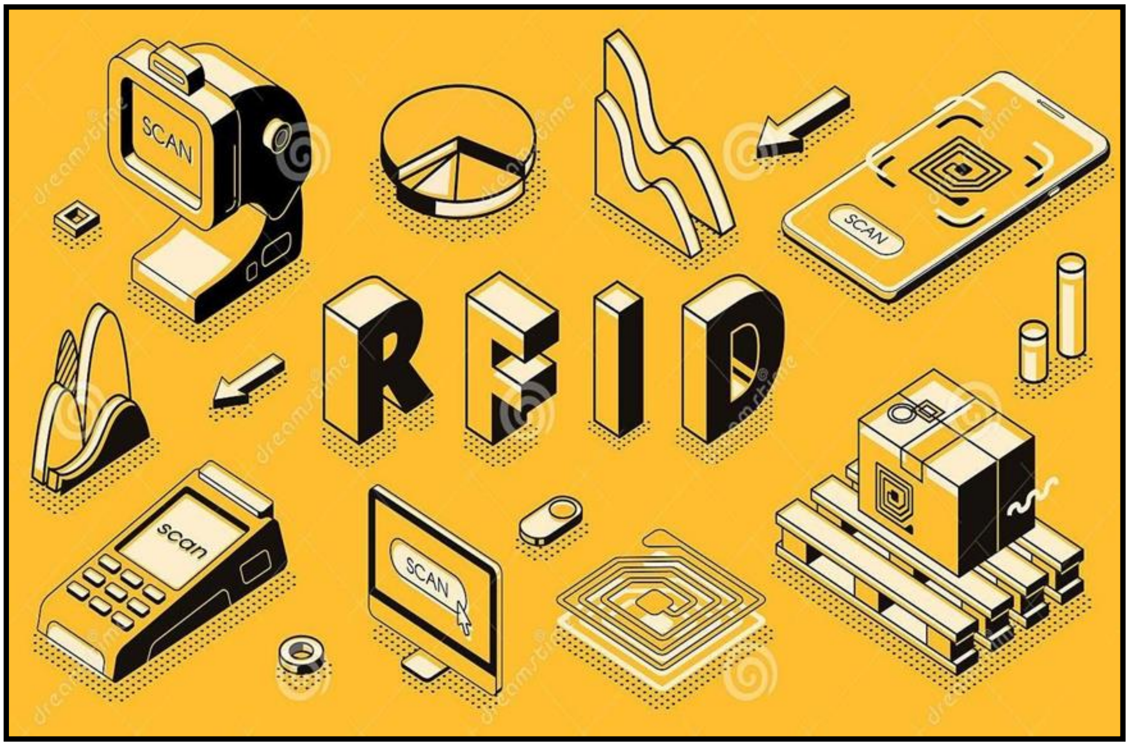

Fig 1 : RFID Technology

3.3. RFID IMPLEMENTATION:

Since its creation, the RFID chip has come a long way. The progression is shown here.

1940's - In WWII, radar technology was employed to distinguish between friendly and enemy aircraft. Actually, this was the first time RFID was used.

1948 - Scientist and inventor Harry Stockman creates RFID and is credited with the invention.

1963 - New RFID concepts developed by inventor RF Harrington include dispersing information and data.

1977 - The first RFID transmitting license plate is created.

2000 - At this point, more than 1000 patent applications utilising RFID technology have been made.

If you are not one of the businesses using cutting-edge RFID technology, it may be difficult for you to believe that RFID will be commonplace in 20 years. However, you may have adopted this technology to decrease costs and streamline operations. A system that broadcasts an object's identify (in the form of a special serial number) wirelessly using radio waves is known as a radio frequency identification (RFID) system.

The more general Automatic Identification (Auto ID) technologies umbrella includes RFID technology. Long ago, barcode labels helped spark a revolution in identification technologies, yet they are now frequently found to be insufficient. Their limited storage capacity and inability to be reprogrammed present a challenge despite their inexpensive cost.Storing the data on silicon chips was a workable approach. In a perfect world, data would be sent without any interaction between the reader and the data carrying device. In addition, contactless technology would be used to transfer the power necessary to run the electronic data carrying device from the reader. RFID is known for these processes.

Changing the flow of the demand-supply chain is one big commercial goal for RFID. In the current, essentially prehistoric environment, manufacturers create products based on forecasts and hope that every one of them will be consumed before their shelf life expires. Good news provided the market remains steady. It would be terrible if an unexpected increase caused a shortage in supply, costing revenues to every link in the chain. devastating if demand suddenly drops and losses are transferred along the supply chain.Simple idea, not too difficult to put into practise, and potentially revolutionary outcomes. That's RFID in a nutshell.

3.4. RFID TECHNOLOGY AND ARCHITECTURE :

Before RFID can be fully understood, it is crucial to comprehend how radio frequency communication works. Data is sent using electromagnetic waves in RF (Radio Frequency) transmission. A source can identify itself and the information it contains by producing a distinct electromagnetic wave, which has an effect at a receiver located distance from the source.

In an RFID system, the RFID tag that carries the object's tagged data emits a signal that contains the appropriate information. The RFID reader then reads this signal and may pass it on to a processor so that the processor can process the information for the intended purpose.

Thus, the following three elements can be combined to form an RFID system:

1. RFID tag or transponder

2. RFID reader or transceiver

3. Data processing subsystem

A wireless transducer, an antenna, and an encasing substance make up an RFID tag. These tags may be passive or active. Passive tags use the electricity generated by the RFID reader's magnetic field, whereas active tags have power on-chip. As a result, passive tags are less expensive than active tags but have a shorter range (10 mts) and are more vulnerable to environmental and regulatory restrictions. An antenna, transceiver, and decoder are the three main components of an RFID reader, which emits periodic signals to query any nearby tags. It transfers such information to the data processor after receiving any signal from a tag. The system's data processing component offers the tools for handling and storing the data.

3.5. RFID APPLICATIONS AND SECURITY :

For RFID, standards are essential. Be it payment procedures or the monitoring of products in open supply chains. For various RFID frequencies and uses, a lot of work has been put into developing standards.

RFID standards deal with the following: -

- **Air Interface Protocol** - The way tags and readers communicate
- **Data Content** - Organizing of data
- **Conformance** - Tests that products meet the standard
- **Applications** - How applications are used.

It has been a complicated process for the world to develop the standards. The ISO and Auto-ID Centre (currently managed by EPC Global) are two influential and occasionally at odds organisations in the industry. We'll go over the suggested criteria from both of these organisations without getting too into the conflict.

Tags must be thrown away; the manufacturer may not obtain a return from the store to reuse the tags. A standard developer's main goal is to reduce the cost of the tags as a result. Only UHF can give the read range required for supply chain applications, hence it should operate in that frequency band. Furthermore, the standards must be accessible and widely understood as the commodities must be traced as they travel across the globe. There should also be a supporting network architecture that would make it possible for anyone to search up details related to a serial number saved on a tag. Open standards must also underpin the network.

EPC standards for tags are the class 0 and class 1 tags:

Class 1: a simple, passive, read-only backscatter tag with one-time, fieldprogrammable non-volatile memory.

Class 0: read-only tag that was programmed at the time the microchip was made.

Class 1 and Class 0 have a couple of shortcomings, in addition to the fact that they are not interoperable. One issue is that they are incompatible with ISO standards. The new EPC standard ~V Gen2 is designed to be fast tracked with ISO standards but for some disagreements over the 8-bit Application Family Identifier (AFI).

For automatic identification and item management, ISO has created RFID standards. For systems expected to be used to track commodities in the supply chain, this standard, also known as the ISO 18000 series, specifies the air interface protocol. They include all of the significant frequencies utilised by RFID systems globally.

CHAPTER 4

HARDWARE AND SOFTWARE COMPONENTS

4.1. HARDWARE COMPONENTS :

4.1.1. ARDUINO UNO

Arduino is a platform for reading sensors and controlling devices like motors and lights.

An open-source microcontroller development board is called an Arduino. Simply put, you can read sensors and control things using an Arduino. This enables you to publish applications to this forum that can communicate with objects in the real world.

For example, you could monitor the humidity level of a potted plant with a humidity sensor and, if the plant becomes too dry, activate an automatic watering system. Alternatively, you can create a standalone chat server that connects to your internet connection. In essence, the Arduino can communicate in some way with anything that is controlled by electrical. You can probably still interface with it using electrically powered devices (such motors and electromagnets), even if it is not powered by electricity.

Nearly endless options are offered by the Arduino. Therefore, it is impossible for one tutorial to contain all the information you may ever need. Having said that, I've tried my best to provide a basic overview of the essential expertise and information you need to get your Arduino up and running. This should serve as a starting point for additional research and education, if nothing else.

David Cuartielles and Massimo Banzi founded the initial Arduino project in 2003 at the Interaction Design Institute in Ivrea with the goal of offering professionals and students a convenient and affordable means of learning embedded programming.

A USB interface, 14 digital I/O pins (of which 6 are used for PWM), 6 analogue pins, and an Atmega328 microcontroller make up the Arduino UNO, a very useful addition to the world of electronics. Additionally, it supports the Serial, I2C, and SPI protocols, three other communication standards. A microcontroller board called Arduino Uno was created by Arduino.cc and is based on the Atmega328 microprocessor. UNO, which is short for "one" in Italian, is used to identify this board as the first Arduino board ever created.

The Arduino IDE (Integrated Development Environment) is a free download from the Arduino official website that is used for authoring, compiling, and uploading code to Arduino boards.

It operates at a 5V voltage, and the input voltage ranges from 7V to 12V.

The maximum current rating for the Arduino UNO is 40mA, thus the load shouldn't go over this limit or you risk damaging the board.

Arduino Uno Pinout consists of 14 digital pins starting from D0 to D13.

It also has 6 analog pins starting from A0 to A5.

The board can be reset programmatically using the one reset pin that is also present. This pin needs to be made LOW in order to reset the board. Six power pins that offer various voltage levels are also present.

GND on one top, ground and power on the other. The ATMEGA328 used in this updated version 3.0 offers additional memory for data and programming. It has two levels. Thus, it becomes more accessible and less expensive to hack.

You end up paying less with Nano than Mini and USB combined!

Specifications:

Microcontroller	Atmel ATmega328
Operating Voltage (logic level)	5 V
Input Voltage (recommended)	7-12 V
Input Voltage (limits)	6-20 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8
DC Current per I/O Pin	40 mA
Flash Memory	32 KB (of which 2KB used by bootloader)
SRAM	2 KB
EEPROM	1 KB

Clock Speed	16 MHz
Dimensions	0.70‖ x 1.70‖

Features:

•Automatic reset during program download

•Power OK blue LED

•Green (TX), red (RX) and orange (L) LED

•Auto sensing/switching power input

•Small mini-B USB for programming and serial monitor

•ICSP header for direct program download.

•Standard 0.1‖ spacing DIP (breadboard friendly)

•Manual reset switch.

Power:

The Arduino Nano can be powered by a mini-B USB port, an external power supply with a voltage range of 6 to 20 volts (pin 30), or a 5 volt regulated power supply (pin 27). The greatest voltage source is automatically chosen as the power supply. The key features are –

- Arduino boards have the ability to read analogue or digital input signals from various sensors and convert them into an output, such as turning on or off a motor, an LED, connecting to the cloud, or doing a number of other tasks.
- By uploading software using the Arduino IDE, you can control the way your board behaves by giving the microcontroller on the board a set of instructions.
- Arduino does not require an additional piece of hardware (referred to as a programmer) in order to load fresh code into the board, in contrast to the majority of earlier programmable circuit boards. You only need a USB cable.
- The Arduino IDE also makes learning to programme easier by using a condensed version of C++.

- And lastly, Arduino offers a common form factor that separates the micro-controller's features into a more approachable container.

Board Description:

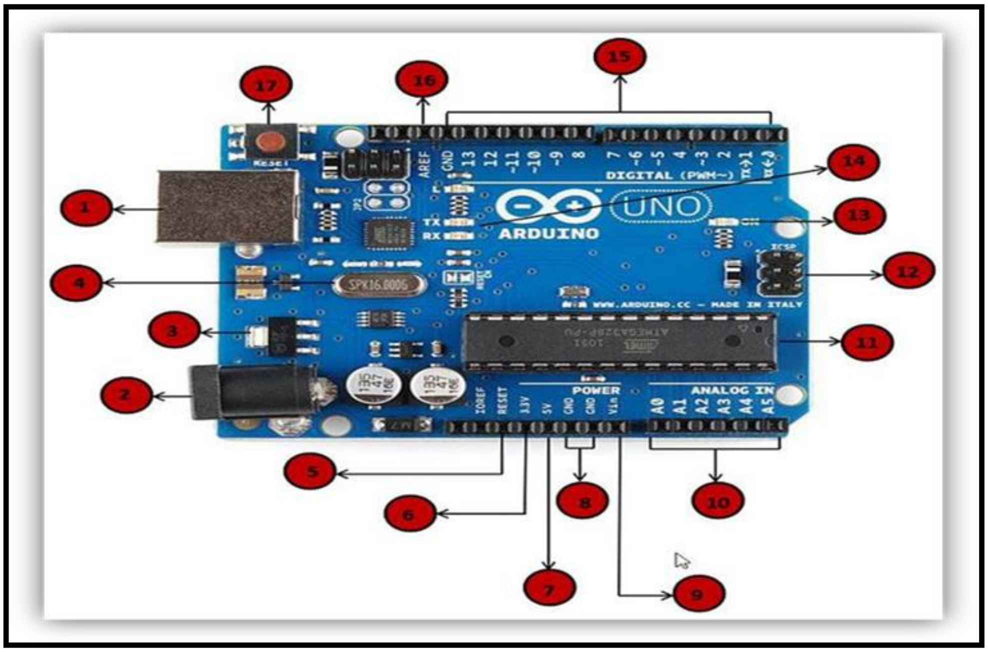

Fig 2 : Arduino Board Pin Diagram

Table 1 : Pin Description of Arduino UNO Board

	Power USB The Arduino board can be powered by your computer's USB cord. Simply attaching the USB cable to the USB connection is all that is required (1).
	Power (Barrel Jack) If an Arduino board is connected to the Barrel Jack (2), it can be powered directly from the AC mains power source.
	**Voltage Regulator** The voltage regulator's job is to regulate the voltage supplied to the Arduino board and maintain the DC voltages that are used by the processor and other components.

4	**Crystal Oscillator** The crystal oscillator assists Arduino in resolving time-related problems. How does the Arduino clock work? The crystal oscillator, is the answer. 16.000H9H is the number etched on the crystal of the Arduino board. It informs us that the frequency is 16 MHz, or 16,000,000 Hertz.
5,17	**Arduino Reset** You can restart your programme from scratch by resetting your Arduino board. There are two ways to restart the UNO board. the reset button (17) on the board, first. Second, you can attach an external reset button to the RESET (5) Arduino pin.
6,7 8,9	**Pins (3.3, 5, GND, Vin)** • 3.3V (6) − Supply 3.3 output volt • 5V (7) − Supply 5 output volt • Most of the components used with Arduino board works fine with 3.3 volt and 5 volt. • GND (8)(Ground) − There are several GND pins on the Arduino, any of which can be used to ground your circuit. • Vin (9) − This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.
10	**Analog pins** The Arduino UNO board has six analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

11	**Main microcontroller** There is a separate microcontroller on each Arduino board (11). You might consider it to be your board's brain. Each Arduino board has a slightly different main IC (integrated circuit). The ATMEL Company typically manufactures the microcontrollers. Before loading up a new programme from the Arduino IDE, you must be aware of what IC your board has. The top of the IC has access to this information. You can consult the data sheet for additional information regarding the

	IC's design and functions.
12	**ICSP pin** ICSP (12) primarily consists of an AVR programming header for the Arduino that includes MOSI, MISO, SCK, RESET, VCC, and GND. SPI (Serial Peripheral Interface) is a term that is frequently used to describe what could be thought of as a "expansion" of the output. Actually, what you are doing is slaving the output device to the SPI bus's master.
13	**Power LED indicator** If your Arduino is powered up properly, this LED should turn on when you put it into a power source. If the light does not illuminate, there is a problem with the connection.
14	**TX and RX LEDs** You will see the labels TX (transmit) and RX (receive) on your board. On the Arduino UNO board, they can be found in two locations. To start, mark the pins in charge of serial communication at the digital pins 0 and 1. The TX and RX lead next (13). While transmitting serial data, the TX led flashes at various rates. The baud rate that the board is using determines how quickly things flash. During the receiving process, RX flashes.
15	**Digital I/O** There are 15 total digital I/O pins on the Arduino UNO board, of which 6 are used to output PWM (Pulse Width Modulation). These pins can be set up to function as digital output pins to drive various modules like LEDs, relays, etc. or as digital input pins to read logic values (0 or 1). PWM can be produced using the pins marked with the symbol.
16	**AREF** Analogue Reference is the acronym for this. It is occasionally used to establish an external reference voltage as the maximum value for the analogue input pins, which is typically between 0 and 5 volts.

4.1.2. LCD (LIQUID CRYSTAL DISPLAY):

An LCD (Liquid Crystal Display) is a kind of flat panel display that operates primarily with liquid crystals. Given that they are frequently utilised in cellphones, televisions, computer monitors, instrument panels, and other products, LEDs offer a wide range of applications for consumers and enterprises. Any number of colour or monochrome pixels are arranged in an array on a thin, flat display that is placed in front of a light source or reflector. A column of liquid crystal molecules suspended between two transparent electrodes, two polarising filters with perpendicular polarity axes, and a column of liquid crystal molecules make up each pixel. Light flowing through one would be obstructed by the other without the liquid crystals separating them. To allow light to flow through the other filter, the liquid crystal twists the polarisation of the light entering the first one.

Types of LCDs:

Types of LCDs include:

- Twisted Nematic (TN)- which provide quick response times at a low cost. However, the contrast ratios, viewing angles, and colour contrasts of TN displays are poor.
- In Panel Switching displays (IPS Panels)- which, when compared to TN LCDs, promise substantially greater contrast ratios, viewing angles, and colour contrast.
- Vertical Alignment Panels (VA Panels)- which are regarded as being in the middle of TN and IPS display quality.
- Advanced Fringe Field Switching (AFFS)- which has the best colour reproduction range among IPS screens.

'Smart LCD' screens are a common form of visual output for microcontroller-based systems. The LCD NT-C1611 module was used to create LCD displays that are affordable, simple to use, and even capable of producing a readout utilising the display's 5X7 dots and cursor. They contain mathematical symbols in addition to the regular ASCII characters. The display needs a +5V supply in addition to 10 I/O lines (RS RW D7 D6 D5 D4 D3 D2 D1 D0) for an 8-bit data bus.

It simply needs the supply lines and six more lines (RS RW D7 D6 D5 D4) for a 4-bit data bus. Data lines are tri-state and do not obstruct the microcontroller's work when the LCD display is not active.

FEATURES:

(1) Interface with either 4-bit or 8-bit microprocessor.

(2) Display data RAM

(3) 80x□8 bits(80 characters).

(4) Character generator ROM

(5) 160 different 5 □□7 dot-matrix character patterns.

(6) Character generator RAM

(7) 8 different user programmed 5 □□7 dot-matrix patterns.

(8) Display data RAM and character generator RAM may be accessed by the microprocessor..

(9) Numerous instructions

(10) Clear Display, Cursor Home, Display ON/OFF, Cursor ON/OFF, Blink

(11) Built-in reset circuit is triggered at power ON.

PIN DESCRIPTION:

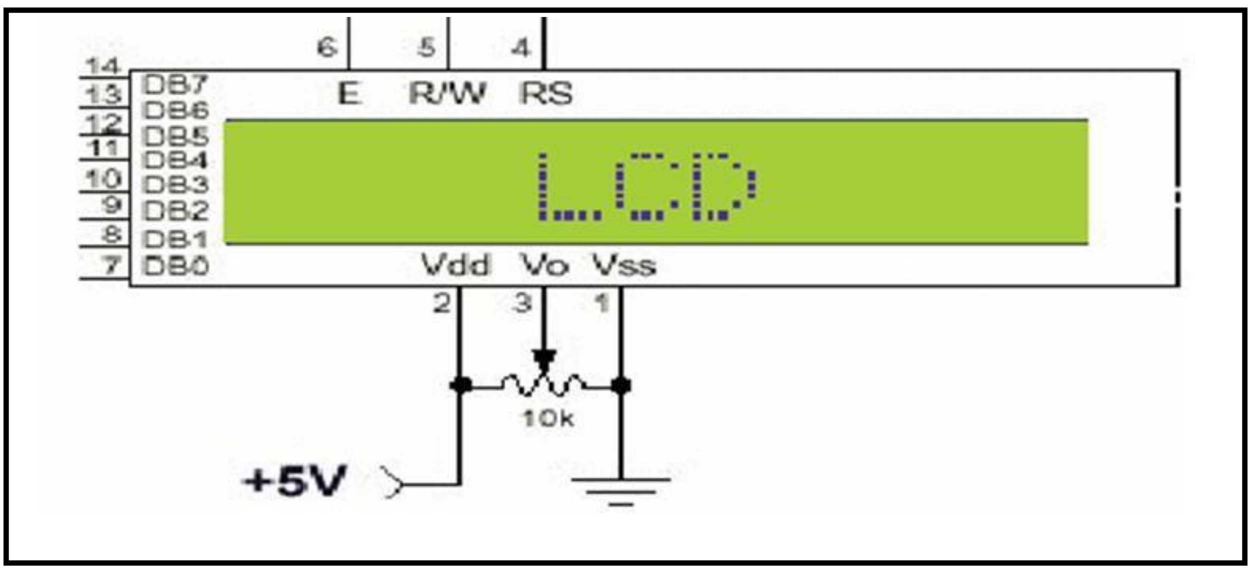

Fig 3: Pin Diagram of 1x16 Lines LCD

Table 2 : Pin Specifications of LCD

PIN	SYMBOL	FUNCTION
1	VSS	Power Supply(GND)
2	Vdd	Power Supply(+5V)
3	Vo	Contrast Adjust
4	RS	Instruction/Data Register Select
5	R/W	Data Bus Line
6	E	Enable Signal
7 – 14	DB0 – DB7	Data Bus Line
15	A	Power Supply for LED B/L(+)
16	K	Power Supply for LED B/L(-)

FEATURES:

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- \+ 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

4.1.3. EM-18 RFID READER:

One of the popular RFID readers for reading 125KHz tags is the EM-18. It has a low price, little power usage, a tiny form factor, and is simple to use. It offers Wiegand26 and UART output formats. It can connect directly to PCs and microcontrollers using UART and an RS232 converter, respectively. After reading tags, it sends a serial unique ID to the PC or microcontroller using Wiegand format or UART connection on the appropriate pins. The EM18 RFID reader reads information from RFID tags that have 12 byte-long stored ID. Line-of-sight is not necessary for the EM18 RFID reader. Additionally, it has a limited identification range, or a few centimetres. The transponder in an RFID tag is struck by a signal when it comes within range of the reader's signal transmission. The electromagnetic field that the reader produces provides electricity to the tag. The transponder transforms that radio signal into usable power after that. When a transponder receives power, it transmits all the data it has stored, including its unique ID, to an RFID reader via an RF signal. Once on the serial Tx (transmit) pin, the RFID reader places this special ID data in the form of a byte. By employing serial UART connectivity, this data can be used or accessed by a PC or microcontroller.

Fig 4 : EM – 18 Reader Module

CONFIGURATION :

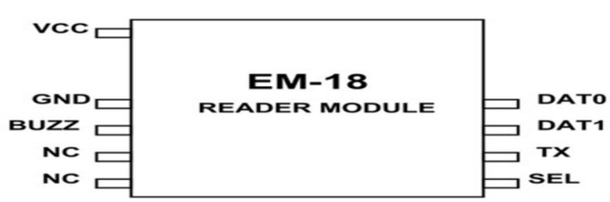

Fig 5 : 2 D – Model of EM – 18 Reader EM – 18 Pin

Table 3 : Pin Configuration of EM – 18 Module

PIN NUMBER	DESCRIPTION
VCC	Connect to the positive terminal of the power supply..
GND	Must be plugged into a grounding source.
BUZZ	Should be connected to BUZZER
NC	No Connection
NC	No Connection
SEL	SEL=1 then o/p =RS232 SEL=0then o/p=WEIGAND

TX	DATA is given out through TX of RS232
DAT1	WEIGAND interface DATA HIGH pin
DAT0	WEIGAND interface DATA LOW pin

EM-18 FEATURES &SPECIFICATIONS:

- Operating voltage of EM-18: +4.5V to +5.5V
- Current consumption:50mA
- Can operate on LOW power
- Operating temperature: 0ºC to +80ºC
- Operating frequency:125KHz
- Communication parameter:9600bps
- Reading distance: 10cm, depending on TAG
- Integrated Antenna

WORKING OF EM-18 RFID READER MODULE:

The module emits a frequency of 125KHz through its coils, and when a passive RFID tag operating at 125KHz enters the proximity of the module, it becomes energized by the emitted field. These passive RFID tags typically utilize CMOS IC EM4102, which draws sufficient power from the generated field to enable its functionality. By adjusting the modulation current flowing through the coils, the tag can transmit the information stored in its pre-programmed memory array.

4.1.4 RFID TAG:

RFID tags are an effective tracking system that employs intelligent barcodes to identify various items. The term RFID stands for "radio frequency identification," indicating that RFID tags utilize radio frequency technology. These tags rely on radio waves to transmit data to a reader, which subsequently sends the information to an RFID computer program. While RFID tags are commonly used in retail for merchandise tracking, they also find applications in vehicle, pet, and even Alzheimer's patient tracking. Additionally, an RFID tag may be referred to as an RFID transponder.

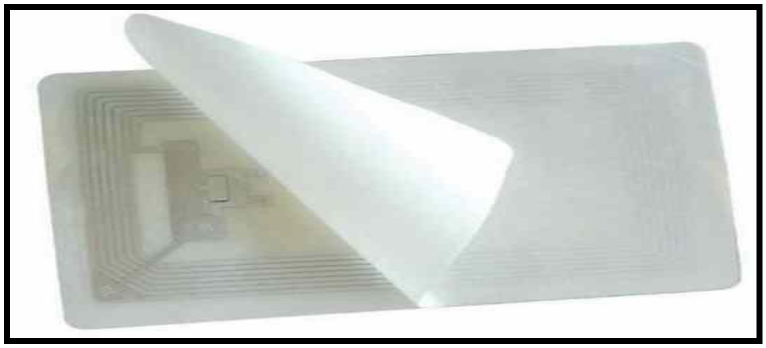

Fig 6 : RFID Tag

RFID tags can be broadly classified into two main types: battery-operated and passive. Battery-operated RFID tags, as the name implies, are equipped with an onboard battery that serves as their power source. In contrast, passive RFID tags operate by harnessing electromagnetic energy transmitted from an RFID reader. Battery-operated RFID tags are sometimes referred to as active RFID tags, distinguishing them from the passive counterparts.

Passive RFID tags are widely favored due to their cost-effectiveness, typically priced at around 20 cents per tag. This affordability has made them a popular option for various applications, including supply chain management, race tracking, file management, and access control. Unlike active RFID tags, passive tags do not necessitate a direct line of sight to the RFID reader. However, they do have a shorter read range in comparison. These tags are compact, lightweight, and have the potential to remain functional throughout a lifetime of use.

WORKING OF RFID TAGS:

The operation of an RFID tag involves the transmission and reception of information through an antenna and a microchip, also known as an integrated circuit or IC. The microchip embedded in an RFID tag can be programmed with customized information as desired by the user.

Passive RFID tags utilize three primary frequencies to transmit information: 125 – 134 KHz, commonly referred to as Low Frequency (LF); 13.56 MHz, known as High Frequency (HF) and Near-Field Communication (NFC); and 865 – 960 MHz, recognized as Ultra High Frequency (UHF). The frequency employed directly influences the range capabilities of the RFID tag.

When a passive RFID tag comes within the scanning range of an RFID reader, the transponder within the tag is impacted by the reader's signal. The tag draws power from the electromagnetic field generated by the reader, allowing the transponder to convert the radio signal into usable power. Once energized, the transponder transmits all stored information, such as a unique ID, to the RFID reader in the form of an RF signal. Subsequently, the RFID reader converts this unique ID data into bytes and transmits it through the serial Tx (transmit) pin. This data can then be accessed or utilized by a PC or microcontroller via UART communication for further processing.

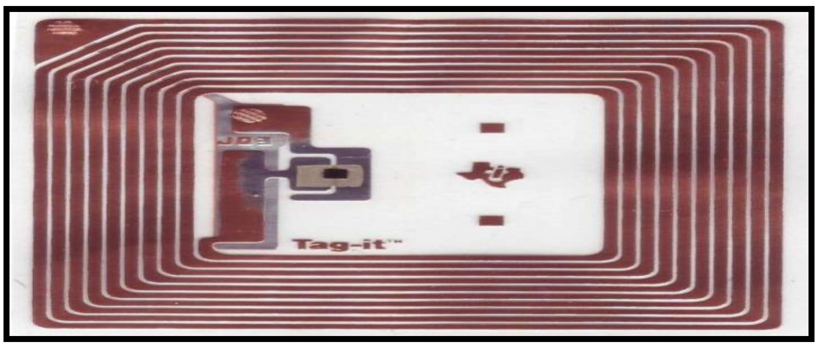

Fig 7 : RFID Tag Inside

The RFID reader emits energy to power the passive RFID tag, providing sufficient power for the chip and antenna to relay information back to the reader. The reader then transmits this information to an RFID computer program for interpretation and further processing. Passive RFID tags can be broadly categorized into two main types: inlays and hard tags. Inlays are usually thin and adhesive, allowing them to be easily affixed to various materials. On the other hand, hard tags, as the name implies, are constructed from sturdy and durable materials like plastic or metal.

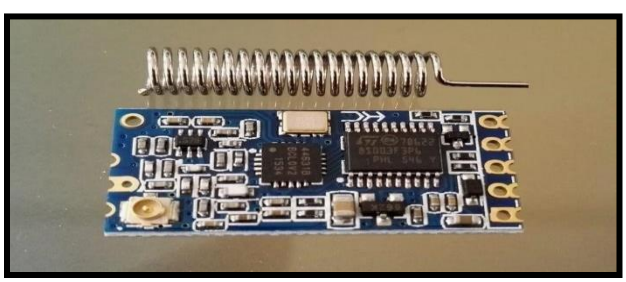

Fig 8 : Inner Structure of RFID

APPLICATIONS:

While RFID tags and barcodes share some common applications, RFID tags offer significantly more advanced features. Unlike barcodes, RFID tags do not require a line-of-sight connection for reading information. They can be scanned from a distance of several meters. Additionally, this characteristic enables a single RFID tag to be read by multiple readers simultaneously, whereas a barcode tag can only be scanned by one reader at a time.

RFID tags have a versatile application range and can be attached to a wide variety of objects. While they are commonly used for items such as apparel, baggage, containers, construction materials, laundry, and bottles, they can also be applied to animals, humans, and vehicles. Certain RFID tags are specifically designed for rugged, outdoor environments, built to withstand natural and artificial light, vibrations, shocks, rain, dust, oil, and other challenging conditions. These tags are typically passive, meaning they do not require batteries and can operate continuously without the risk of power loss. Heavy-duty RFID tags are commonly affixed to trucks, cargo containers, and light rail cars for purposes such as cargo tracking, fleet management, vehicle tracking, vehicle identification, and supply container tracking, among other applications.

4.1.5 HC-12 TRANSCEIVER :

The HC-12 wireless serial port communication module is an advanced embedded wireless data transmission module that offers multichannel capabilities. It operates within the wireless frequency band of 433.4-473.0MHz, allowing for the configuration of multiple channels with a stepping of 400 KHz. In total, there are 100 available channels for selection. The module has a maximum transmitting power of 100mW (20dBm) and a receiving sensitivity of -117dBm at a baud rate of 5,000bps in open air. It can achieve a communication distance of up to 1,000m in an open space environment.

The HC-12 wireless serial port communication module is designed with a stamp hole enclosure and can be easily integrated into application systems. Its compact dimensions are 27.8mm × 14.4mm × 4mm (including antenna cap, excluding spring antenna). The module provides convenient options for antenna connectivity. It features a PCB antenna pedestal (ANT1) for the use of an external antenna operating at 433MHz frequency through a coaxial cable. Additionally, it has an antenna solder eye (ANT2) that allows for the easy attachment of a spring antenna. Users can choose the appropriate antenna based on their specific requirements.

The module incorporates an integrated microcontroller (MCU), eliminating the need for separate programming. It operates in a transparent transmission mode, solely responsible for receiving and sending serial port data, making it user-friendly. The module supports multiple serial port transparent transmission modes, which can be selected by using AT commands according to specific usage needs.

In terms of power consumption, the module offers three modes: FU1, FU2, and FU3. The average idle current for these modes is 80μA, 3.6mA, and 16mA, respectively. The maximum working current is 100mA during transmission.

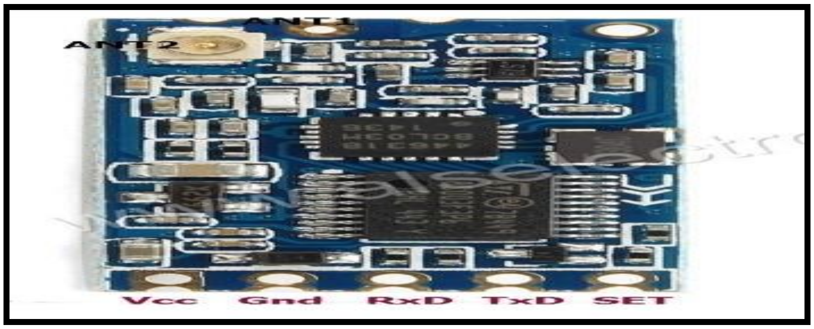

Fig 9 : HC 12 Transceiver

The HC-12 wireless serial port communication module incorporates a built-in MCU, eliminating the need for separate programming by the user. It operates in a transparent transmission mode, focusing solely on the reception and transmission of serial port data, which enhances convenience during usage. The module supports multiple serial port transparent transmission modes, which can be selected by using AT commands to meet specific requirements.

In terms of power consumption, the module offers three modes: FU1, FU2, and FU3. During idle state, the average working current for FU1 is 80μA, for FU2 is 3.6mA, and for FU3 is 16mA. The maximum working current occurs during transmission and is capped at 100mA.

The Si4463 Transceiver

The wireless communication in this circuit is facilitated by the Si4463 chip. This chip offers a maximum transmit power of 20 dBm (100 mW) and a receive sensitivity of 129 dBm, enabling robust wireless communication. Additionally, the Si4463 chip incorporates two 64-byte FIFO memories for both receiving (Rx) and transmitting (Tx) data.

Furthermore, the Si4463 chip encompasses a plethora of advanced features that are not implemented in the HC-12 design. These features include multiband operation, frequency hopping, and more. For detailed information on these advanced capabilities, I recommend referring to the datasheet of the Si4463 chip.

The STM8S003FS Microcontroller

The microcontroller used in this circuit is an 8-bit microcontroller with 8 kB of flash memory, 128 bytes of EEPROM, and a 10-bit ADC (Analog-to-Digital Converter). It provides support for popular communication protocols such as UART, SPI, and I²C, and it features multiple I/O pins for versatile connectivity.

In terms of functionality, this microcontroller offers similar capabilities to other 8-bit microcontrollers like the ATMega and XMC series. It is programmed to control the Si4463 chip, managing its operations and settings. Additionally, it handles the UART communication between the HC-12 module and the device it is connected to on the other end, facilitating data exchange.

The HC-12 Transceiver Module

The HC-12 transceiver is formed by combining the Si4463 and STM8S003 components. It offers a 4-pin TTL-level UART interface, consisting of Vcc, Gnd, Tx, and Rx pins. Additionally, there is a 5th pin dedicated to entering "command" mode, allowing users to modify the configuration of the module.

The HC-12 transceiver supports 100 channels with a spacing of 400 kHz between each channel. It provides eight transmit levels to adjust the power output, allowing for different ranges and power consumption levels. The module also offers support for eight baud rates, enabling flexibility in data transmission. Furthermore, the HC-12 operates in three distinct working modes, providing versatility for various application requirements.

FEATURES:

- Long-distance wireless transmission (1,000m in open space/baud rate 5,000bps in the air)

- Working frequency range (433.4-473.0MHz, up to 100 communication channels)
- Maximum 100mW (20dBm) transmitting power (8 gears of power can be set)
- Three working modes, adapting to different application situations
- Built-in MCU, performing communication with external device through serial port
- The number of bytes transmitted unlimited to one time
- Update software version through serial port

SPECIFICATIONS:

- Working frequency: 433.4MHz to 473.0MHz
- Supply voltage: 3.2V to 5.5VDC
- Communication distance: 1,000m in the open space
- Serial baud rate: 1.2Kbps to 115.2Kbps（default 9.6Kbps）
- Receiving sensitivity: -117dBm to -100dBm
- Transmit power: -1dBm to 20dBm
- Interface protocol: UART/TTL
- Operating temperature: -40℃ to +85℃
- Dimensions: 27.8mm x 14.4mm x 4mm

INSTRUCTIONS:

1. AT

Test instructions

Example: Send module commands "AT", the module returns "OK".

2. AT + Bxxxx

Change the serial port baud rate command. You can set the baud rate is 1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps and 115200bps. The factory default is 9600bps.

Example: Set the module serial port baud rate is 19200bps

1200 bps	5000 bps	-117 dBm
2400 bps	5000 bps	-117 dBm
4800 bps	15000 bps	-112 dBm
9600 bps	15000 bps	-112 dBm
19200 bps	58000 bps	-107 dBm
38400 bps	58000 bps	-107 dBm
57600 bps	236000 bps	-100 dBm
115200 bps	236000 bps	-100 dBm

Table 4 : Module Serial Port Baud Rate

3. AT + Cxxx

The wireless communication channel of the HC-12 transceiver can be changed and selected from a range of 001 to 127. It is important to note that beyond the first 100 radio channels, the communication distance cannot be guaranteed. By default, the operating frequency is set to 433.4MHz, and the channel spacing is 400KHz. For example, setting the module to channel 21 requires sending the module command "AT + C021," and upon successful configuration, the module will return "OK + C021." Once the command mode is exited, the module will operate on channel 21 with an operating frequency of 441.4MHz.

Please keep in mind that due to the high sensitivity of the HC-12 wireless receiver module, when the baud rate exceeds 58,000bps, it is necessary to shift to the adjacent channel by five steps. This applies even when the air baud rate is not greater than 58,000bps for short-distance communication (up to 10 meters). It is advisable to utilize adjacent channels to avoid interference in such scenarios.

4. **AT + FUx**

To change the serial pass-through mode of the module, there are three available modes: FU1, FU2, and FU3. The default mode is FU3. It is important to note that for successful communication, both modules involved in the serial pass-through mode must be set to the same mode.

For example, to set the module to FU1 mode, you can send the command "AT + FU1" to the module. Upon successful configuration, the module will respond with "AT + OK," indicating that the mode has been changed to FU1.

5. **AT + Px**

The default setting for the HC-12 module is the maximum transmit power level. By default, the module operates at the highest power level to achieve the maximum communication distance. The transmit power level can be adjusted, with a range from 1 (minimum transmission power) to the maximum power level.

For example, to set the transmit power level to 5, you can send the command "AT + P5" to the module. Upon successful configuration, the module will respond with "OK + P5," indicating that the transmit power level has been set to +11 dBm. After exiting the command mode, the module will operate with the specified transmit power level, enabling effective wireless communication at the adjusted power level.

It is worth noting that with each 6dB drop in transmit power, the communication distance is typically reduced by half. Adjusting the transmit power level allows for balancing power consumption and desired communication range.

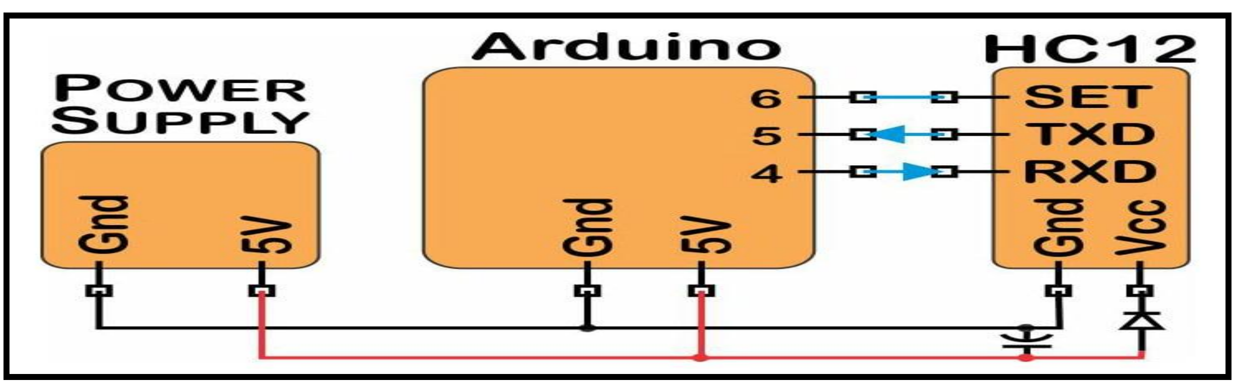

Fig 10 : Working of HC 12 Transceiver

Each HC-12 can work in one of the following modes:

1. FU1 – moderate power saving mode with 250000bps ―over the air‖ baud rate. Serial port baud rate can be set to any supported value

2. FU2 – extreme power saving mode with 250000bps ―over the air‖ speed. Serial port rate is limited to 1200bps, 2400bps, 4800bps

3. FU3 – default, general purpose mode. ―Over the air‖ speed differs depending on serial port speed. The same goes for maximum range:

   ○ 1200bps ~ 1000m o 2400bps ~ 1000m o 4800bps ~ 500m o 9600bps ~ 500m o 19200bps ~ 250m o 38400bps ~ 250m o 57600bps ~ 100m o 115200bps ~ 100m

4. FU4 (available in version 2.3 or newer) – long-range mode. ―Over the air‖ speed is limited to 500bps and serial port speed to 1200bps. Because airspeed is lower than port speed, only small packets can be sent: max 60 bytes with the interval of 2 seconds. In this mode, range is increased to 1800m.

Pair of HC-12 that creates a wireless link has to work in the same mode (FU1, FU2, FU3, FU4) and with the same speed.

APPLICATIONS:

- Wireless sensor
- Community building security
- Robot wireless control
- Industrial remote control and telemetering
- Automatic data acquisition
- Container information management
- POS system
- Wireless acquisition of gas meter data
- Vehicle keyless entry system
- PC wireless networking

4.1.6. PUSH BUTTON:

A push button is a commonly used type of switch that is employed to initiate or control an action in a machine or process. These buttons are typically made of plastic or metal, and their shape may be designed to conform to fingers or hands, ensuring easy and comfortable operation. Alternatively, they may have a flat surface, depending on the specific design requirements.

Push buttons can be categorized as either normally open (NO) or normally closed (NC). In the case of a normally open push button, the switch contacts are not connected in their resting state. Pressing the button closes the contacts and completes the circuit, allowing current to flow and initiating the desired action. Conversely, a normally closed push button has its contacts connected in the resting state, and pressing the button opens the contacts, interrupting the circuit and stopping the intended action.

The selection of a normally open or normally closed push button depends on the specific application and the desired behavior when the button is pressed.

Fig 11 : Push Button

WORKING:

Push button switches typically consist of three main components: the actuator, stationary contacts, and the mechanism.

The actuator is the part of the switch that is pressed by the user. It can come in various shapes and sizes, depending on the design and application. When the actuator is pressed, it exerts force on the other components of the switch.

The stationary contacts are fixed parts of the switch that do not move. They are typically made of conductive material and are positioned in such a way that they come into contact with the movable contact when the actuator is pressed. These contacts are responsible for completing or interrupting the electrical circuit when the switch is activated.

The mechanism inside the switch consists of a movable contact and a spring. The movable contact is connected to the actuator and moves along with it. The spring provides the necessary tension to keep the movable contact in its resting position. When the actuator is pressed, the movable contact comes into contact with the stationary contacts, allowing current to flow or causing the desired action to occur.

Depending on the specific design, some push buttons may require the user to continuously hold the button for the action to take place. In other cases, a latch mechanism may be incorporated, which keeps the switch in an activated state until the user presses the button again to release the latch and turn off the switch. The specific functionality of the push button switch can vary depending on the intended use and design requirements.

APPLICATIONS:

Push button switches are indeed widely used in various applications, ranging from everyday consumer electronics to commercial and industrial settings. Here are some key points about their usage:

1. Consumer Electronics: Push button switches can be found in devices such as calculators, push button phones, remote controls, and various home appliances. They enable users to turn devices on and off, adjust settings, or trigger specific functions.

2. Commercial and Industrial Applications: Push button switches are extensively used in commercial and industrial settings to control machines, equipment, and processes. They can initiate or halt operations, activate alarms, or perform specific actions based on the requirements of the application.

3. Mechanical Linkage: In certain scenarios, push buttons can be connected through mechanical linkages. This means that pressing one button can trigger the release or activation of another button, allowing for complex control sequences or interlocking mechanisms.

4. Color Coding: Push buttons often feature specific coloration to visually indicate their intended function or action. This color coding helps reduce the risk of accidental activation or confusion. For example, red buttons commonly signify a stop or emergency action, while green buttons often indicate a start or activation command.

5. Emergency Stop Buttons: Emergency stop buttons are an important type of push button switch used in many settings. They are typically designed with a larger size and distinctive appearance to ensure quick identification and easy access in critical situations. Emergency stop buttons are often colored red and can be found in industrial machinery, medical equipment, and other safety-critical systems.

Push button switches provide a simple and intuitive interface for controlling devices and performing actions, making them a versatile and widely adopted component in various applications.

4.2. SOFTWARE COMPONENTS

The Arduino Software (IDE) is a user-friendly and open-source development environment for writing code and uploading it to Arduino boards. It supports Windows, Mac OS X, and Linux, and is built on Java and other open-source software. It simplifies the coding process and can be used with any Arduino board. The IDE features a text editor, compiler, and firmware uploader, along with pre-built libraries for various tasks. It has a supportive community and extensive online resources. Overall, it provides a convenient and accessible platform for programming Arduino boards.

4.2.1. INSTALLATION

For this project, we have installed Arduino 4.0 by choosing either the Installer (.exe) or the Zip package. The Installer package is recommended as it automatically installs all the necessary components, including drivers, for using the Arduino Software (IDE). On the other hand, with the Zip package, we shall need to manually install the drivers. The Zip file is useful if we prefer a portable installation. After downloading the chosen package, proceed with the installation and make sure to allow the driver installation process if prompted by the operating system.

4.2.1.1. How to install :

Many steps are taken to install the Arduino 4.0 in our desktop. They are explained by the figures below.

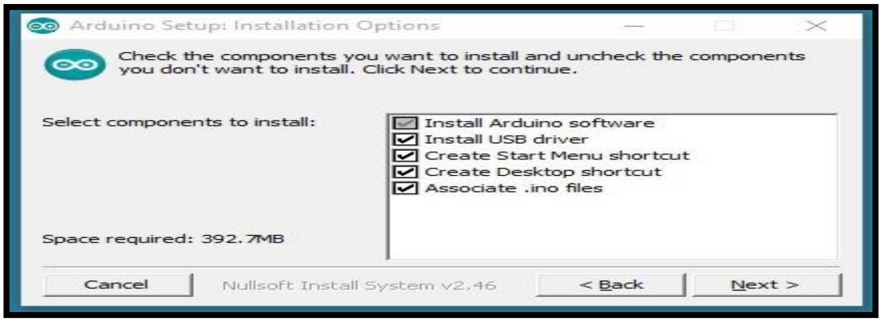

Fig 12 : Choose the Components to Install

4.2.1.2. Choose the installation dictionary :

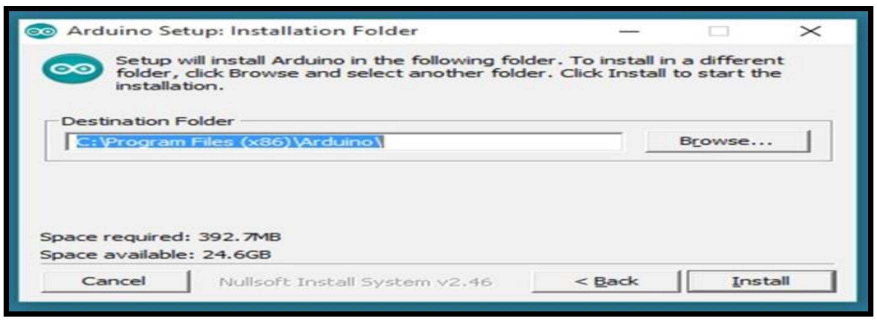

Fig 13 : Choose the Installation Directory (Suggested to Keep the Default One

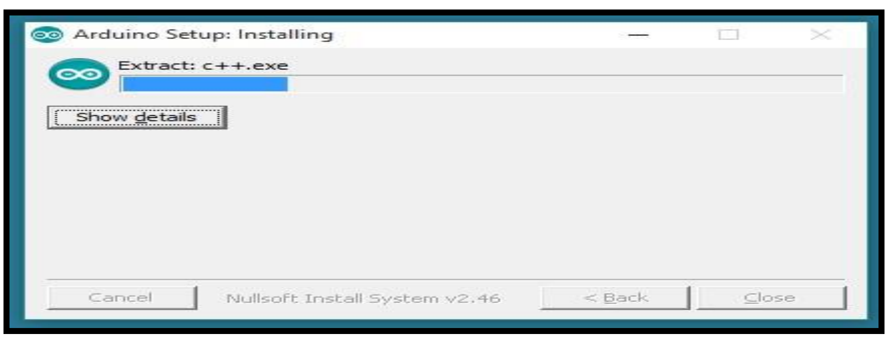

Fig 14 : Extracting and Installing Files

The process will extract and install all the required files to execute properly the Arduino Software (IDE).

CHAPTER 5

METHODOLOGY OF PROJECT

The mall implements an RFID system using 125kHz frequency tags. Each product is equipped with a unique RFID tag, and a reader (EM-18) is attached to the trolley. When a customer purchases a product, the reader scans the tag, and the Arduino receives the tag's unique Electronic Product Code (EPC). The Arduino then displays the product information and updated cost on an LCD screen. Simultaneously, the information is transmitted to a central PC using an HC-12 transmitter on the trolley and an HC-12 receiver on the PC.

To remove a product from the bill, the customer rescans the corresponding product tag, and the cost is deducted accordingly. A push button is available on the trolley to indicate the end of shopping. When pressed, the final bill is displayed on the LCD, and payment can be made using precharged cards, which are unique RFID tags assigned to each customer. These cards contain customer identification numbers and available balance. Customers can make payments at the trolley by scanning their precharged cards. The LCD screen also shows the remaining balance on the card after the transaction.

5.1. BLOCK DIAGRAM

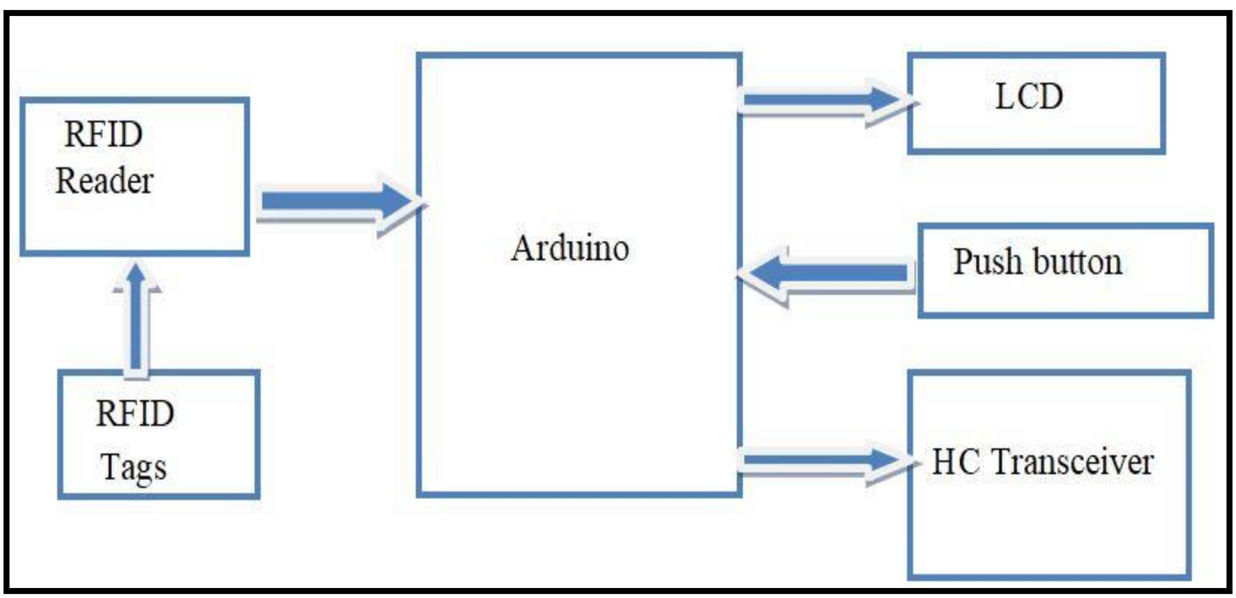

Fig 15 : Block Diagram

5.2 ALGORITHM

Here are the steps involved in the RFID-based shopping cart system:

Step 1: Initialize the shopping cart by resetting it.

Step 2: Read the RFID tag attached to the product using the reader. If the tag is read an odd number of times, it indicates that the corresponding item should be added to the cart.

Step 3: If the RFID tag is read an even number of times, it signifies that the item should be subtracted from the cart.

Step 4: Press the reset button to calculate the total billing amount, which is then displayed on the LCD screen.

Step 5: Use the precharged card (RFID tag) to debit the amount from the cart.

Step 6: After the final billing is completed, transmit the billing information via the HC-12 transmitter. The respective person at the billing section can receive and observe the transmitted data.

These steps outline the basic workflow of the RFID-based shopping cart system, where RFID tags are used to add or remove items from the cart and facilitate payment using precharged cards.

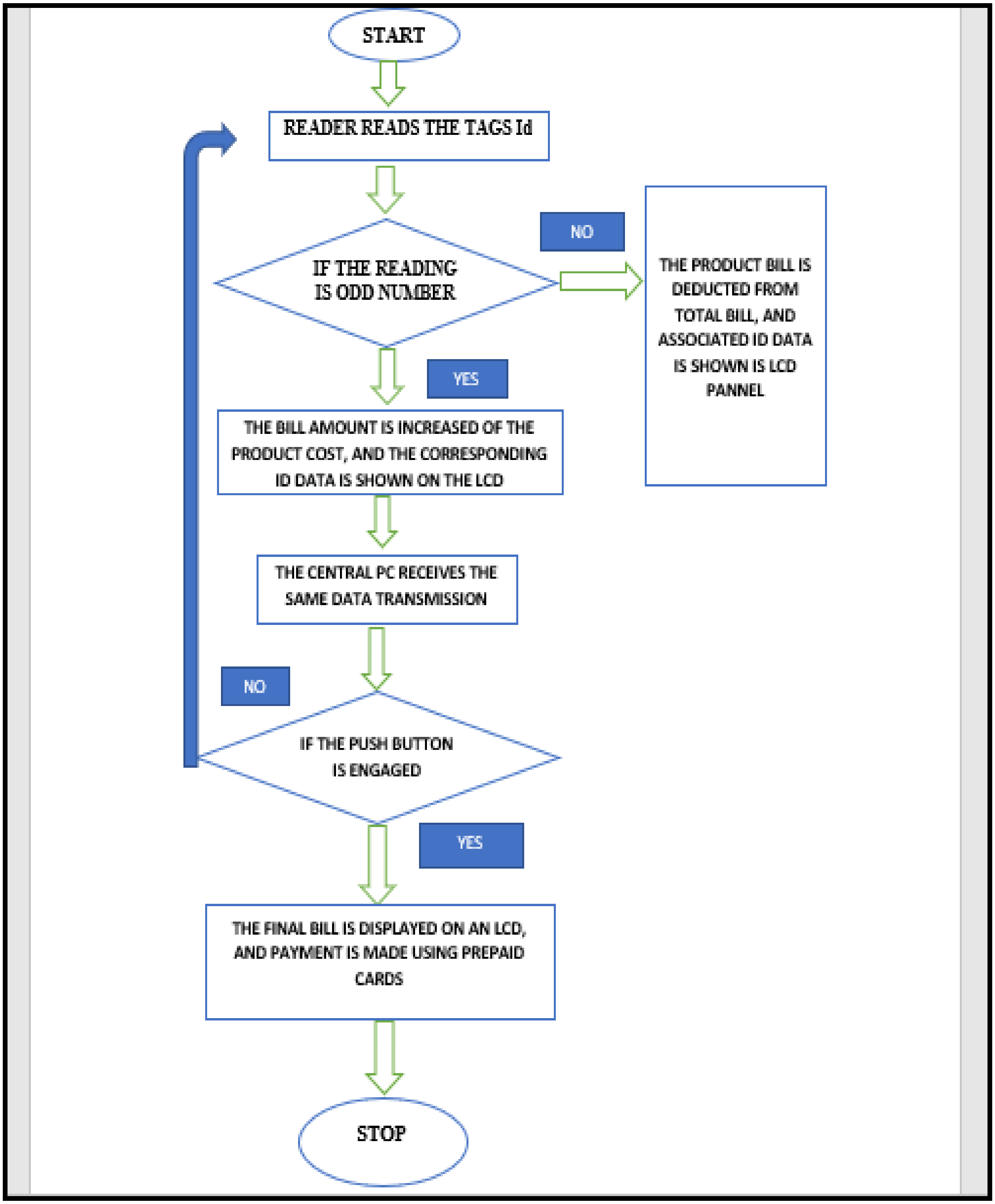

Fig 16 : Flow Chart

5.3. CONNECTION

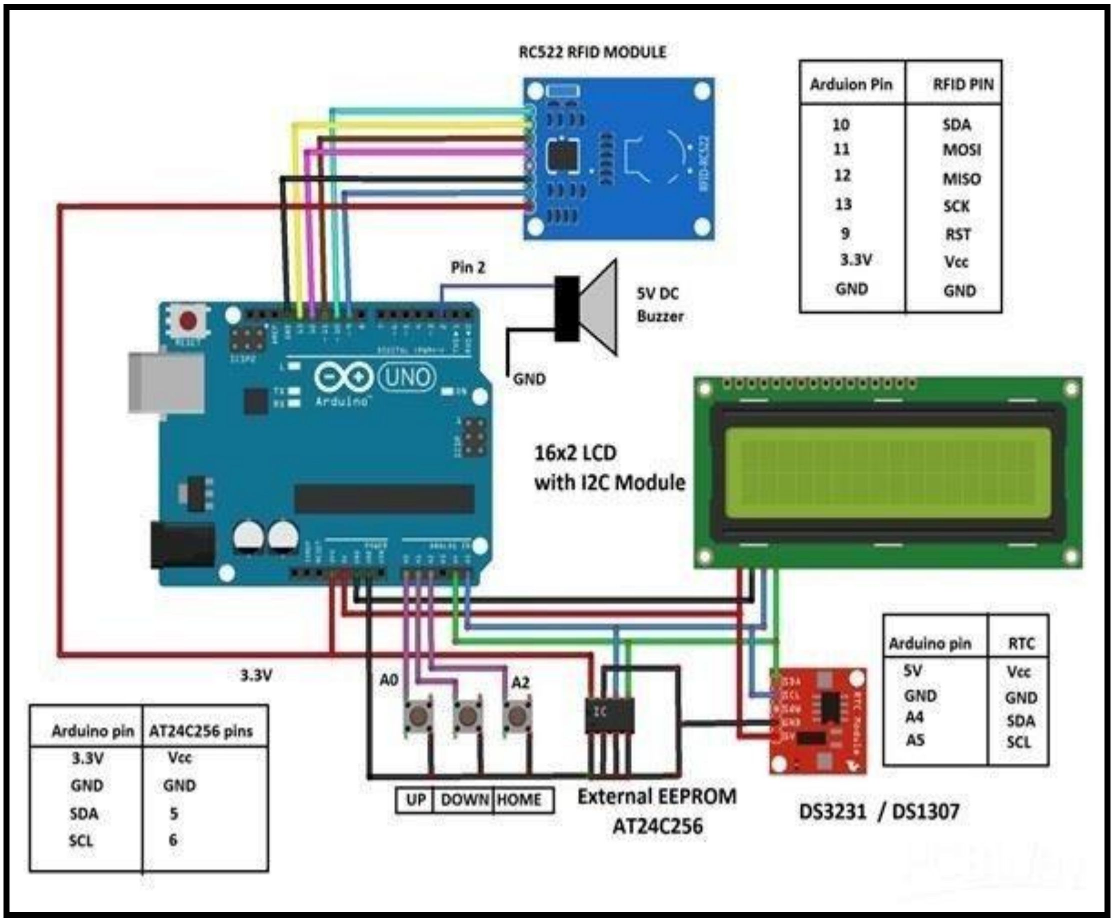

Fig 17 : Connection Diagram

CHAPTER 6

RESULTS AND DISCUSSION

In conclusion, implementing a "Smart trolley utilizing RFID" in the retail marketing business can be a valuable solution to stay competitive and adapt to changing trends in consumer purchasing. The benefits of time and labor savings are evident. However, the cost of implementing technologies that capture data about item interactions is currently high, making them less accessible for the consumer market. Additionally, decoding and interpreting the collected data can be challenging due to the lack of established taxonomy and consistent classification systems. Although efforts to standardize are underway, it may take time to achieve widespread adoption. Another challenge is integrating new technology into existing retail infrastructure, which often relies on outdated and incompatible systems. Despite these challenges, investing in technological advancements can help retailers enhance their offerings and improve the overall shopping experience for customers.

6.1 Output of the Project

Fig 18 : Welcome to Super Market

Fig 19 : Automatic Billing System

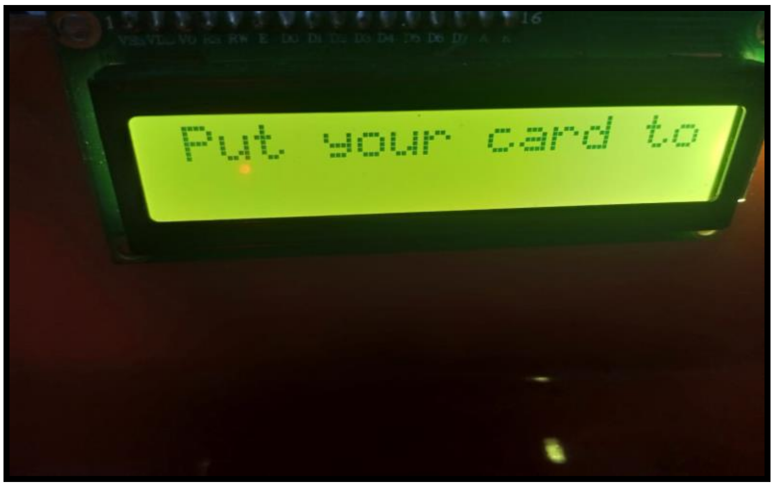

Fig 20 : Card Scanning Process

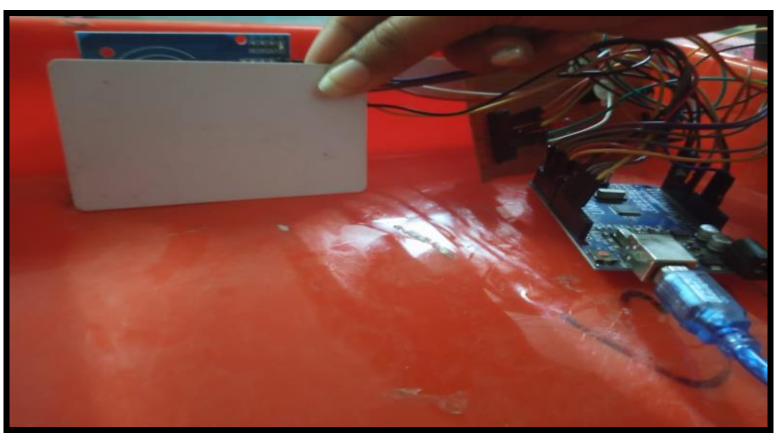

Fig 21 : Scan for Product 1

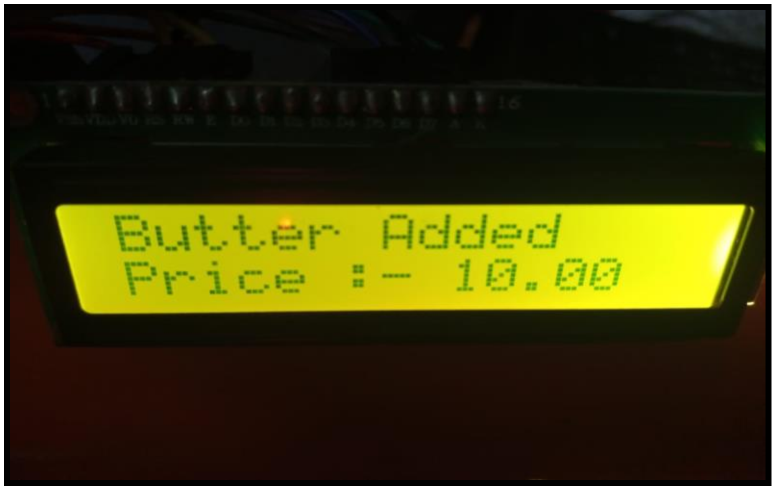

Fig 22 : Butter Added

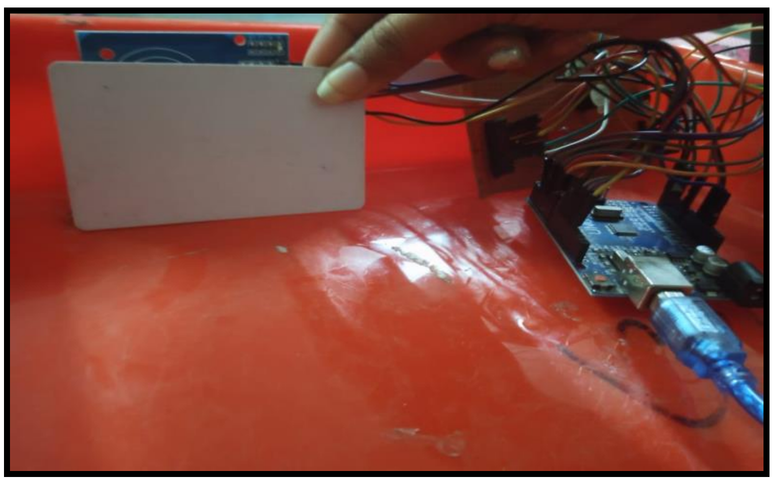

Fig 23 : Scan for Product 2

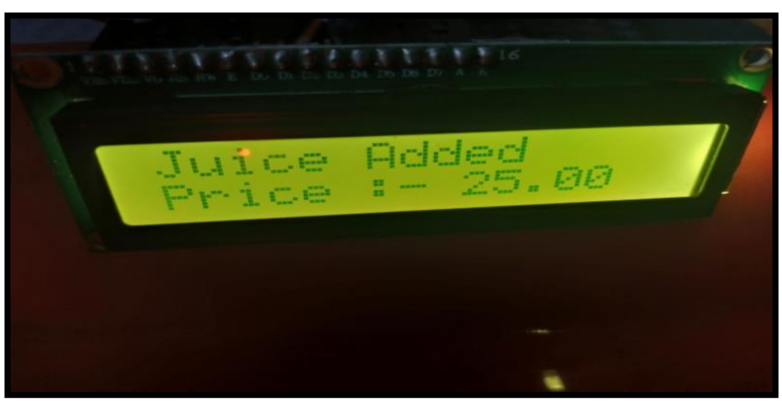

Fig 24 : Juice Added

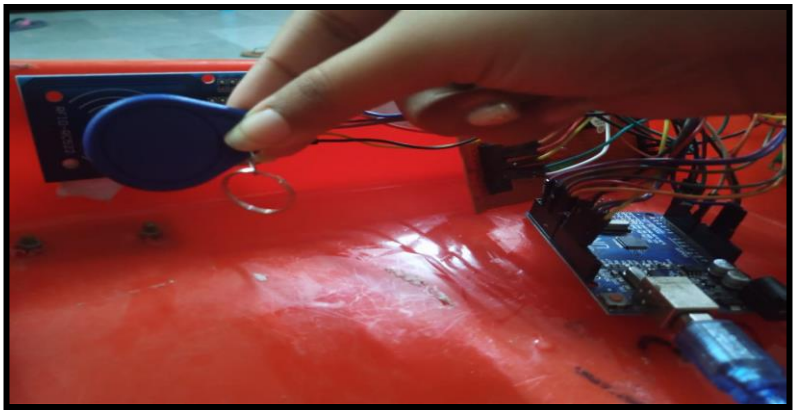

Fig 25 : Scan for Product 3

Fig 26 : Chocolate Added

Fig 27 : Total Amount Calculated

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1. CONCLUSION

The Smart Trolley System offers convenience to customers by eliminating the need to wait in queues for product scanning. During busy periods, such as weekends or festivals, this saves significant time for customers. The system is designed for customers with membership cards that contain RFID tags, allowing them to use the smart trolley. Supermarkets and hypermarkets utilize this concept as a business strategy to attract more customers.

To ensure accurate product information, the details of the items are regularly updated in the trolley's memory unit using Internet of Things (IoT) technology and software. The trolley is equipped with optical sensors, motors, and motor drivers that enable it to follow the customer while maintaining a safe distance.

The smart trolley incorporates a camera and a load cell. The camera scans the products, while the load cell measures their weight. All the information, including scanned products and total weight, is displayed on the LCD screen. This enables customers to receive a flexible and accurate bill for their purchases.

Overall, the Smart Trolley System enhances the shopping experience by streamlining the checkout process, providing up-to-date product information, and enabling convenient and efficient billing for customers.

7.2. FUTURE SCOPE

The major goal of the smart trolley is to save the client's time. By doing this, the crowds that may collect in malls in the future due to population growth may be prevented, computation time is cut down, the likelihood of an error is decreased, and the consumer is able to save money. There won't be any money-related stress while shopping if one can effortlessly purchase items that fit their budget. It can be utilized widely after this.

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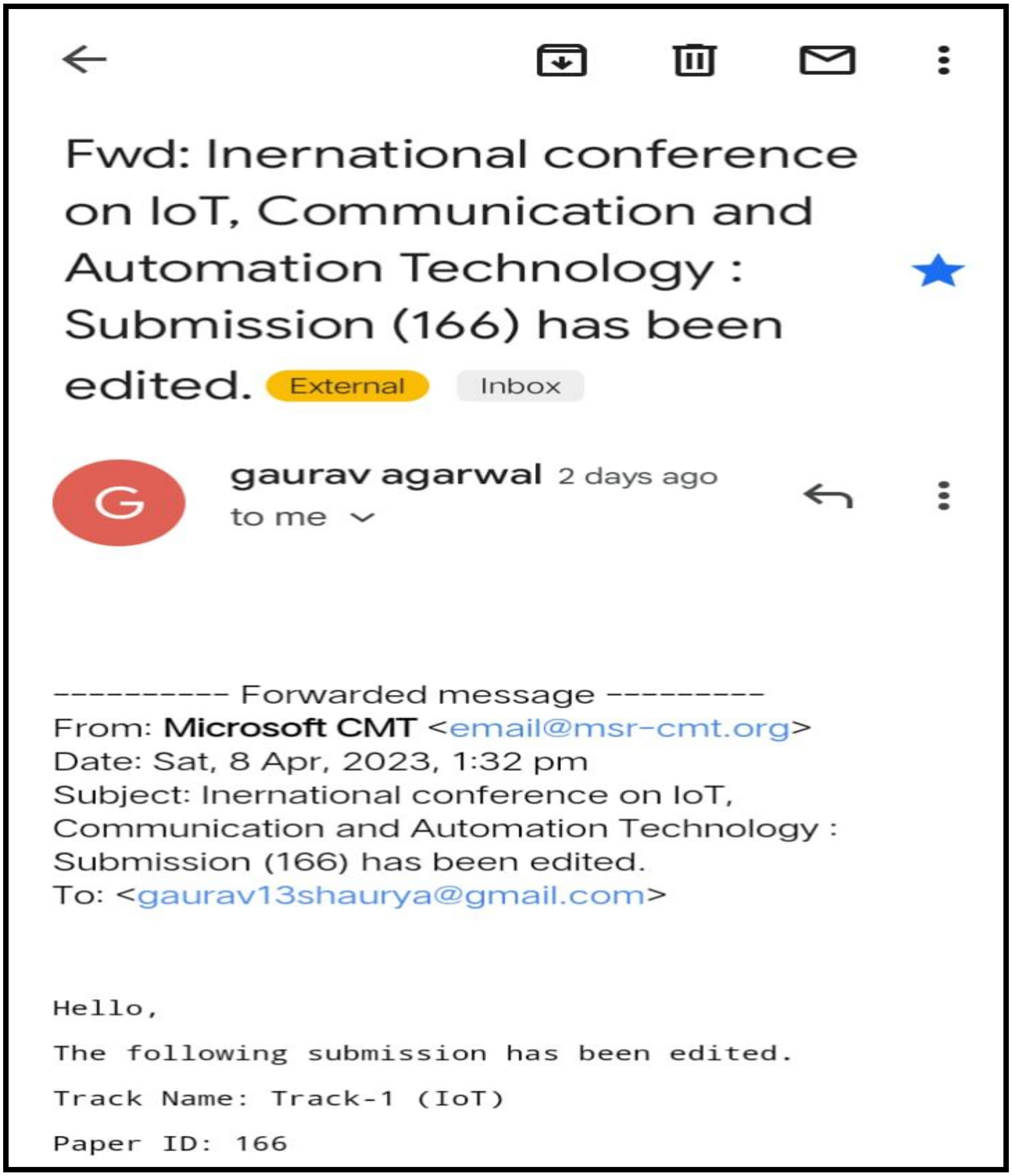
APPENDIX 1

PROJECT OUTCOME : RESEARCH PAPER



Fwd: Inernational conference on IoT, Communication and Automation Technology : Submission (166) has been edited. External Inbox

gaurav agarwal 2 days ago

to me

---------- Forwarded message ---------
From: **Microsoft CMT** <email@msr-cmt.org>
Date: Sat, 8 Apr, 2023, 1:32 pm
Subject: Inernational conference on IoT, Communication and Automation Technology : Submission (166) has been edited.
To: <gaurav13shaurya@gmail.com>

Hello,

The following submission has been edited.

Track Name: Track-1 (IoT)

Paper ID: 166

Fig 28 : Email of Communication

Paper Title: THE IOT-BASED SMART SHOPPING TROLLEY SYSTEM

Abstract:
This research paper presents an IoT-based smart trolley system for supermarkets that aims to provide customers with an improved shopping experience. The system consists of a smart trolley equipped with sensors and microcontrollers that interact with a cloud-based server and a mobile application. This involves designing the hardware and software components of the smart trolley, including the IoT sensors, RFID reader, microcontroller, display screen, and user interface. The system will communicate with a cloud-based server that stores and processes data from the sensors and provides real-time analytics for store managers. The trolley can detect the items placed in it and display the total cost of the purchase on an LCD screen. The mobile application allows customers to view the list of items in their trolley, their prices, and the total cost, search for items, and navigate to their locations in the supermarket. The cloud-based server collects and analyzes data from the trolleys and generates insights for supermarket management, such as popular products, inventory levels, and customer footfall. The proposed system has the potential to enhance the shopping experience for customers and provide valuable insights into supermarket management

Created on: Sat, 08 Apr 2023 08:00:46 GMT

Last Modified: Sat, 08 Apr 2023 08:01:51 GMT

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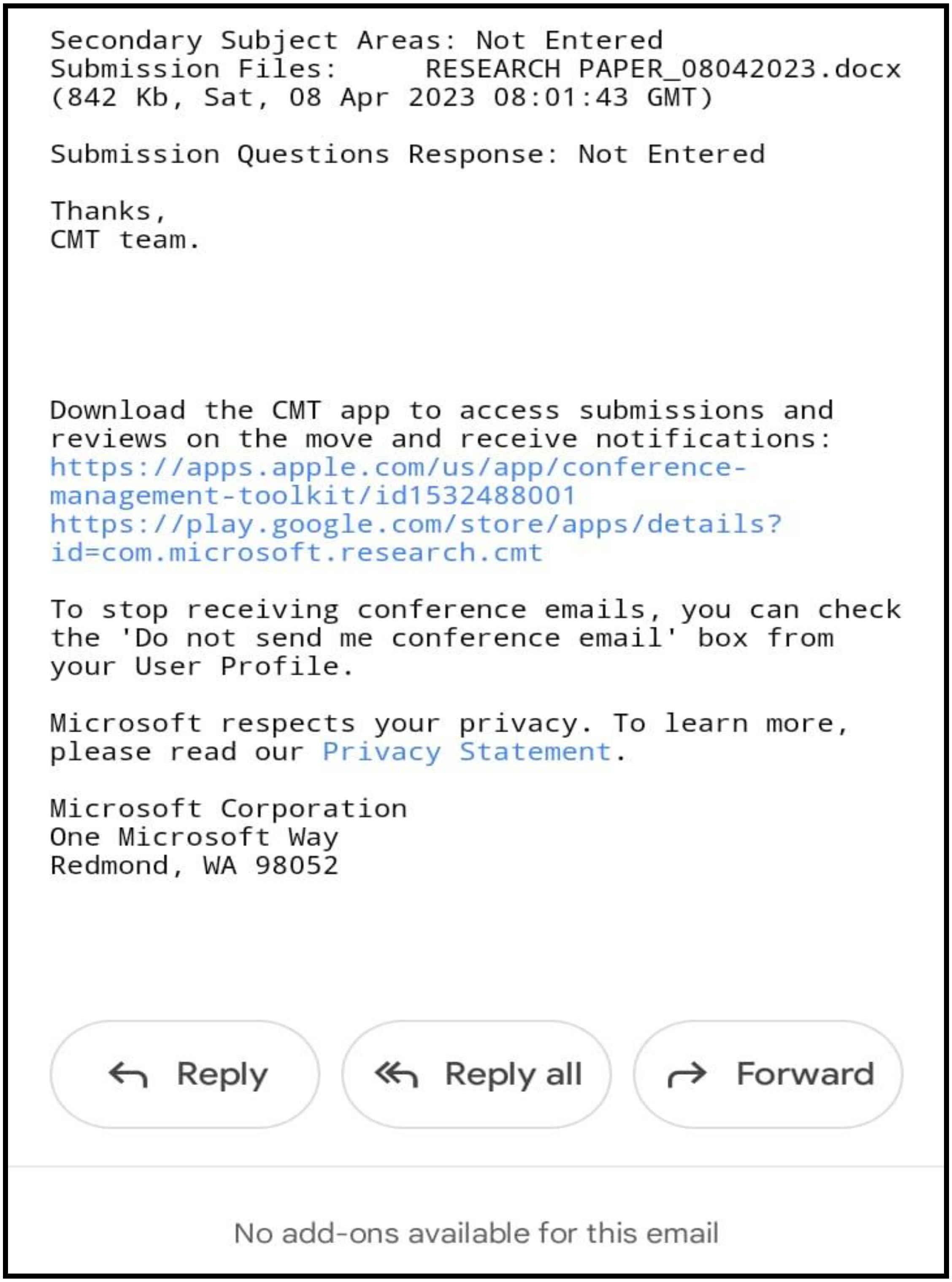
Secondary Subject Areas: Not Entered
Submission Files: RESEARCH PAPER_08042023.docx (842 Kb, Sat, 08 Apr 2023 08:01:43 GMT)

Submission Questions Response: Not Entered

Fig 29 : Email of Communication



Secondary Subject Areas: Not Entered
Submission Files: RESEARCH PAPER_08042023.docx (842 Kb, Sat, 08 Apr 2023 08:01:43 GMT)

Submission Questions Response: Not Entered

Thanks,
CMT team.

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Microsoft Corporation
One Microsoft Way
Redmond, WA 98052

Reply
Reply all
Forward

No add-ons available for this email

Fig 30 : Email of Communication

THE IOT-BASED SMART SHOPPING TROLLEY SYSTEM

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***Abstract*— This research paper presents an IoT-based smart trolley system for supermarkets that aims to provide customers with an improved shopping experience. The system consists of a smart trolley equipped with sensors and microcontrollers that interact with a cloud-based server and a mobile application. This involves designing the hardware and software components of the smart trolley, including the IoT sensors, RFID reader, microcontroller, display screen, and user interface. The system will communicate with a cloud-based server that stores and processes data from the sensors and provides real-time analytics for store managers. The trolley can detect the items placed in it and display the total cost of the purchase on an LCD screen. The mobile application allows customers to view the list of items in their trolley, their prices, and the total cost, search for items, and navigate to their locations in the supermarket. The cloud-based server collects and analyzes data from the trolleys and generates insights for supermarket management, such as popular products, inventory levels, and customer footfall. The proposed system has the potential to enhance the shopping experience for customers and provide valuable insights into supermarket management**.

Keywords— RFID Tag, RFID Reader, Microcontroller, Display screen, QR Scanner

I. INTRODUCTION

Our ideas and expectations are changing significantly as a result of numerous advancements and information technologies over the course of the century. Shopping is a common activity where people spend the most time. According to a survey, people spend between one and two hours shopping, and most people always have a tendency to leave a long line of people behind them. Every supermarket and shopping center in the modern day has a shopping cart and baskets for patrons to keep their purchases. Customers must proceed to the billing counter for checkout once their purchasing is complete. Here, the billing procedure takes a long time and necessitates adding more staff to the purchase. We are adopting an RFID-based smart trolley system to reduce traffic, save time, and eliminate manual labor as a solution to this issue. Our prototype contains a few improved features that will fix the queue problem. The smart trolley system includes an Arduino Uno, Buzzer, LCD Display, RFID Tag, and RFID Reader. A product has an RFID tag connected to it. The RFID reader automatically scans the products as a person places them in the trolley, and the information about the product name, price, and quantity is shown on the LCD.

II. RELATED WORK

A. Smart shopping trolley using RFID

The mall and market are great places for customers to buy the items they need on a daily basis, such as name-brand groceries, clothing, and home décor. A consumer uses an RFID reader to scan the item and place it in a shopping cart after traveling to a mall to do his or her shopping. The quantity of the goods is then shown on the LCD, helping the customer establish a budget. Every item has an RFID tag. If the consumer decides against buying the item, he will scan it once more, and it will then be taken out of the trolley. The customer will use the push button in the shopping cart to complete the billing once he is through shopping.[1]

B. RFID-based shopping trolley with IR sensor

Even if individuals are currently highly busy with their schedules, they still need to make time to go shopping and acquire whatever they need in order to meet their fundamental necessities. They lose time once more waiting in those long lines at the checkout in the mall. Also, there is a large crowd that causes other customers to have issues; our system was launched to solve this issue. The barcode scanner on the item that the customer wishes to purchase reads the our system's LCD screen is built-in and has an RFID tag attached to it that displays the item's pricing. The total amount will be shown on the LCD when the consumer is ready to pay for all of the products. Using a ZigBee connection from the host computer, the cost of the product is supplied to the microcontroller. Zigbee enables two-way communication between the host PC and the microcontroller. The backlog is ultimately reduced since the client receives a direct bill in the billing part that is already stored on the host Computer. [2-3]

C. RFID-Based Smart Trolley for Automatic Billing System

In the paper, the "Elegant Shopping Cart System" is presented, which will use an RFID reader, transmitter, and receiver to calculate the cost and save a record of the products that are purchased. Based on a consolidated database of user purchases, the system will offer product recommendations. Each product in the market is attached to an RFID tag in the "Smart Shopping Cart System," Moreover, an RFID reader is included with each trolley, an LCD display, an alphanumeric display, a transmitter, and a receiver.[4]

D. Shopping and Automatic Billing Using RFID Technology

In order to construct an "on the spot" billing supermarket, this article offers an architecture that combines radio frequency identification (RFID) with wireless technologies. The shopping cart utilizes an RFID reader and tag-based system application, and as a result, RFID cards are employed as secure access to the goods. The product name, price, and total value of all the items purchased are displayed on the liquid crystal display (LCD), which is mounted on a cart. Using ZigBee connectivity, the host computer creates foot notation. The Proteus software system and hardware are used to simulate software systems and the microcontroller 18F46K22 respectively.[5]

E. A Deep Learning Enabled Smart Shopping Cart

This study utilized the q-learning and YOLO algorithms to develop a deep-learning CNN method (You Only Look Once). For product analysis and object detection, YOLO algo is employed. YOLO find the item in the trolley. The YOLO algorithm does a good job of predicting the object in the box. It operates quickly and detects the object or objects clearly. Q-learning grows off of prior knowledge on its own. The trolley's contents are located by YOLO and Q-Learning. With the use of a management tool, they were able to track the trolley's location and control its motions. They are in charge of the trolley, yet they are unable to escape. The trolley is entirely under internet control.[6]

F. Smart basket algorithm approach used for shopping in supermarkets using a rechargeable smart cart

The authors of this study make use of an RFID card, reader, and tag as well as a GSM module. The product has an RFID tag that provides the product description, which the RFID reader reads. Each user receives an RFID card for payment, and each client must recharge the card in order to pay bills at a mall or store.
The customer presses the start button on the shopping cart to begin their purchase. The customer must click the end button after making a purchase. In order to generate the bill and transfer it to their phone number, the end button sends data to the Arduino and GSM module. The customer pays the invoice amount using an RFID card that may be recharged.[7-9]

III. PROPOSED SYSTEM

This is the current shopping system used in supermarkets and malls. The item(s) being purchased must be taken by the consumer and placed in a cart. After making his selections, he must proceed to the billing counter and stand in line until it is his turn to pay. When he finally approaches the counter after standing in a long line, the barcode reader must scan each item in order to create the final bill. This is a highly laborious and time-consuming task. We have suggested our system, which operates as follows, to make consumers' shopping quick and simple. Each item in the store will have a distinct RFID tag attached to it.
The RFID reader built into the cart will read the tags as soon as a customer chooses the products they wish to purchase and as soon as the user places the things in the cart in order to identify the items for billing. On the trolley's LCD display, the item's name and price will be shown. The customer will press the submit button on the cart when he is finished. Following the creation of the final bill, all information regarding the things that were purchased will be pushed for billing. Simply give the specific trolley number of your trolley when you approach the billing counter, and you will receive a printed charge. He can settle the bill right away and leave the store to continue working.

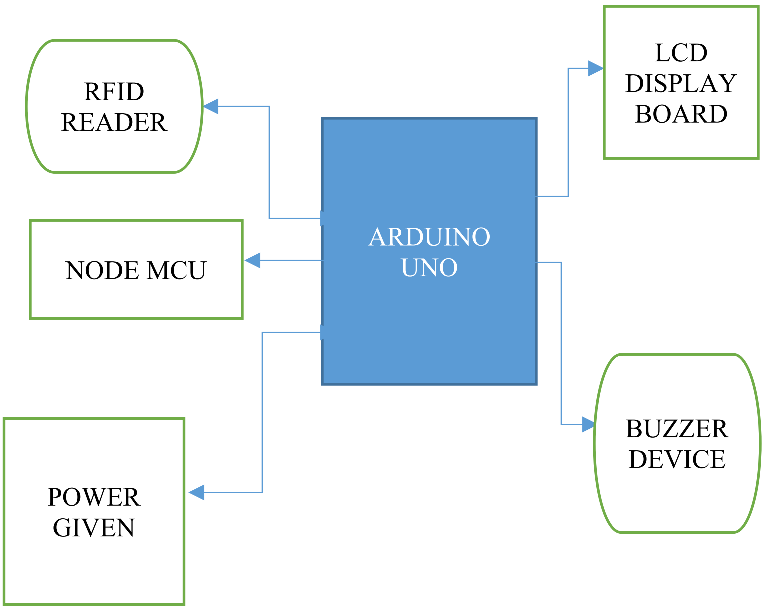

Fig 1: Block Diagram [7]

IV. ALGORITHM USED

STEP 1: The cart is originally at reset.
STEP 2: After that, the reader reads the RFID TAG. In the event that the tag is read an odd number of times, the item is placed to the shopping cart.
STEP 3: If the RFID TAG is scanned an even number of times, the cart is deducted.
STEP 4: Once more, the complete billing amount is shown on the LCD screen after hitting the reset button.

STEP 5: Then the sum of the amount is taken out of the cart using the pre-charged cart.
STEP 6: Once the final billing is completed, sent via the HC-12 transmitter, and seen by the appropriate person in the billing section.[10-14]

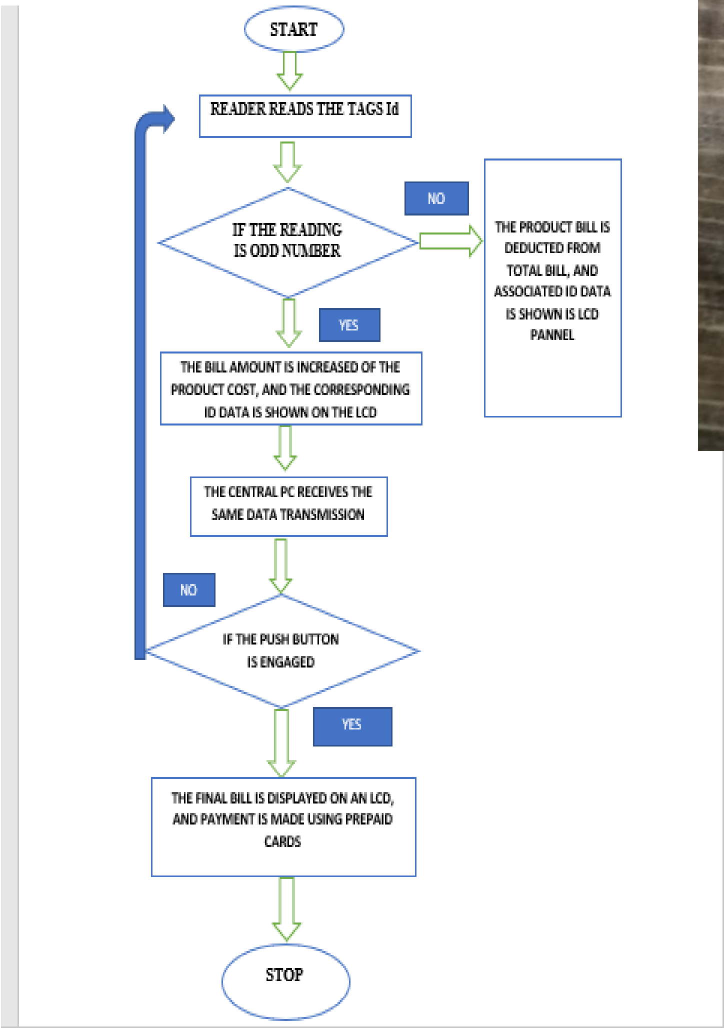

Fig 2: Flow Chart

V. HARDWARE USED

A. ARDUINO UNO FOR CREATING BILLS

In 2010, Arduino. cc released the first version of their public-domain microcontroller board, the Arduino Uno. The Microchip ATmega328P is the main part of Arduino Uno. Input and Output pins on the board are made of both analog and digital pins, where many connection boards and other circuits can be connected. The board has six analog input and output pins, and fourteen digital input and output pins where six of which may create Pulse width modulation and is programmable through a type basic(B) Universal serial bus cable using the Arduino IDE. In addition to operating within the range of 7-20 volts, it may also be powered by a Universal serial bus cable or a nine-volt battery. The Commons attribution two decimal five licensed is on the webpage for Arduino, which is bundled with the hardware reference module. Accessible layouts and production files are also available for specific hardware variants.[15],[16]

Fig 3: Arduino UNO Board

3UZZER

ɪuzzer is an aural signaling tool that can be either hanical, electromechanical, or piezoelectric (abbreviated o). Alarm clocks and timers are two common ications for buzzers and beepers.[17]

.CD

rucial component of an embedded system is a liquid tal display. It gives the user a lot of versatility because he show the necessary data on it. The LCD is connected to microcontroller through the LCD driver. We adjust the)'s contrast, the interface mode, the display mode, the direction in which the address counter increments, the horizontal or vertical addressing mode, and the color format. Initialization is followed by the transfer of data bytes to the required RAM memory region for the display data.
It is necessary to first provide the location using the set command byte before delivering data bytes and Double data random access memory write command used to send data byte. One of two typical layouts for connections is either 2 series rows of 7 pins or 1 series row of 14 pins.[18],[19],[20]

Fig no 4: LCD

D. RFID RC522 READER

While the Arduino uno is constantly in communication with the server, the RFID reader will assist in scanning the product id and sending it to the Arduino. Arduino obtains product information from a server, compares it with information from scanned products, generates invoices, and stores the information in the server.[21]

Fig no. 5: RFID Reader

E. RFID TAG

Smart barcodes are a sort of tracking technology used by RFID tags to recognize objects. RFID is short for "radio frequency identification," RFID tags exploit this innovation. The reader receives the data from the tag through these radio waves and then transfers it to the PC program. The use of RFID tags is common most probably used to trace commodities, however, they can also be utilized to trace automobiles, animals, and citizens who are suffering from Alzheimer's disease. RFID tags are another name for RFID tags. The microchip in an RFID tag is installed on a substrate with a radio antenna and has a 12-byte unique identification number.[22],[23]

Fig No 6: RFID Tag

F. NODE MCU

The open-source IoT platform Node MCU is inexpensive. The first components were ESP-12 module-based hardware and ESP8266 Wi-Fi SoC-based firmware. Subsequently, support for the 32-bit ESP32 MCU was included. For the open source. Free prototype board designs for Node MCU firmware are available. Node MCU is an acronym for node micro-controller unit. Technically, Node MCU refers to the corresponding development tools. One and all RFID card is linked to a single product, and an RFID reader put on the cart may read the product information, including the cost and other details then transfer it to the Node MCU ESP8266. Following that, Node MCU processes the items in the cart and their total value before sending those results to the ESP8266 Webserver.[10]

Fig No. 7: Node MCU

G. AN IR SENSOR

In order to sense particular aspects of its environment, an electrical gadget called an infrared sensor which commonly ascertains or gives out infrared radiation. In addition to monitoring an object's heat production, infrared sensors have the ability to spot movement. To identify the customer in our project, we are employing IR sensors.[11]

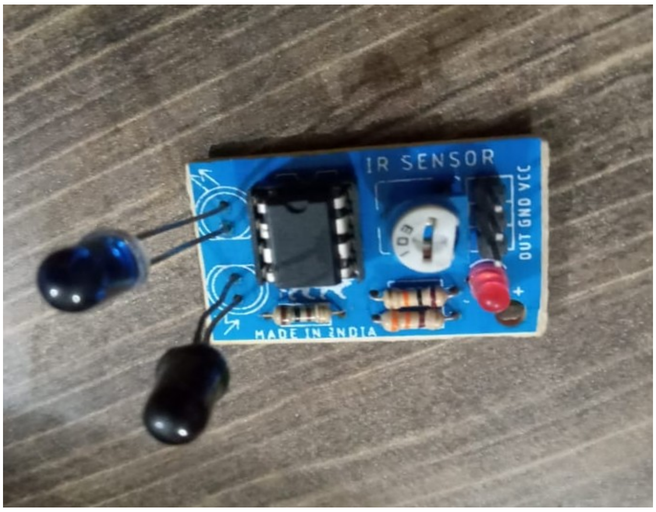

Fig No. 8: IR sensor

H. PUSH BUTTON:

A push button is a basic sort of switch that regulates a machine's or process's behavior. Metal or plastic is typically used to make the buttons. Push buttons can be flat or designed to fit comfortably around hands or fingers for use. Everything depends on the particular design. The push button has two default positions: open and closed.[18]

VI. CONCLUSION

We are prepared to draw the conclusion that a "Smart trolley utilizing RFID" is certainly a superb solution for the retail marketing business to expand its portfolio and keep up with technological advancements in light of the shifting trends in retail purchasing. It is obvious that saving time and labor is necessary. Yet, because they are very expensive, technologies that record data regarding interactions between actual items don't seem to be developed enough for the consumer market. Even if such knowledge has been made available, its decoding is frequently just as challenging as its registration because there is no established taxonomy or consistent classification system. There are numerous attempts to standardize, but it will probably take years. The need to integrate new technology into the retail infrastructure that currently exists, which frequently uses outdated and incompatible systems, is a related issue. Also, the setup for retail sales results in a large increase in the volume of electronic transactions, which present systems cannot handle. Hence, using the conclusion as support, we can state that: Automated billing of products using the notion of a smart trolley will be a more practical choice in the future. The system performs admirably and is effective and small. The trolley's commercial usefulness will be the first of its type. With the assistance of the appropriate sensors, this device records the data of various products.

VII. FUTURE WORKS

The major goal of the smart trolley is to save the client's time. By doing this, the crowds that may collect in malls in the future due to population growth may be prevented, computation time is cut down, the likelihood of an error is decreased, and the consumer is able to save money. There won't be any money-related stress while shopping if one can effortlessly purchase items that fit their budget. It can be utilized widely after this.

VIII. REFERENCES

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Technology, Surampalem “Smart basket algorithm approach for shopping in super market using rechargeable smart card”

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